AGRICULTURE AND LIFE

ARTHUR D. CROMWELL

Courtesy Hoard's Dairyman

PROFESSOR HOLDEN SHOWING CHILDREN HOW TO STRING SEED CORN

"We are beginning a new agriculture, not continuing an old."—*Bailey.*

AGRICULTURE AND LIFE

A TEXT-BOOK FOR NORMAL SCHOOLS AND TEACHERS' READING CIRCLES

BY

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143 ILLUSTRATIONS IN TEXT

The thoroughly satisfactory text is apparently yet to be written. Efforts enough have been made but they have fallen short of anticipation. It is probable that the most useful book is one that attempts to awaken an interest in country life.—L. H. BAILEY.

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PREFACE

This book was written for teachers. It was written by one who for years has taught Agriculture and Nature Study to pupils of all grades and ages. Most of the book consists of lectures delivered many times before Farmers' and Teachers' Institutes. The book is intended for Teachers' Reading Circles and Normal Training Classes.

This book does not take the place of the text-book, such as Davis's Productive Farming. This book is written by one of a large number of teachers who believe that we should teach from things largely and teach by having pupils do things worth while at home. This book should be of help on the teacher's desk as a guide for her daily work.

Agriculture must at all times be closely correlated with the home activities of the pupils. School Agriculture aims to teach things that are new, are a little more worth while doing than what is being done; that being true, a book cannot present matter for all time and cover our big, varied country. The best things to do will be changing, and hence a book is hardly off the press before it is out of date. A book on teaching Agriculture will be valuable for its suggestions and for the enthusiasm it puts into the teachers to take hold of the work.

The subjects presented in School Agriculture should have seasonal sequence. Schools open in September; at that time the home folk are gathering grain, garden vegetables and seeds. As cold weather approaches the home folk begin to prepare for sheltering the plants and animals; then winter comes and the home folk feed the stock, take part in the grain and stock shows, plan the farm and the work for another year. As spring approaches they become interested in the soil, crop rotations, plowing, etc. It will be noticed that the chapters largely follow the seasonal interests of the folk on the farms.

But it is to be hoped that the teacher will not kill the interest in Agriculture by following too rigidly a course of study. Therefore suggestions are given in nearly every chapter for work to be done in other months of the year.

There is little in the book that is original. James says a genius is a man who can stick in his bill anywhere and draw out what the occasion demands. In that I hope that I have imitated genius. The book owes much to the help of others. There is little in it that has not been tried by some of the teachers in Wright County, Iowa. Mr. O. H. Benson of the United States Department of Agriculture read the manuscript and made a number of suggestions, likewise Professor Kary C. Davis of the George Peabody College for Teachers read the manuscript and made suggestions, many of which were adopted. I am indebted to Professor W. H. Blakely, of Fort Dodge, Iowa; to Superintendent F. A. Welch, of Hampton, Iowa; to A. V. Storms, of the University of Minnesota; to Professor P. G. Holden and Mr. Frank C. Pellet, who furnished both suggestions and photographs; to E. C. Bishop, of Iowa College; to Professor J. F. Monk, of Tobin College; to Professor Smith Burnham and Dr. Samuel Schmucker, who read part of the manuscript, and to Mrs. Cromwell, who read most of the manuscript and who wrote the chapter on birds.

Thanks are due to Ginn & Co. and to Professor Hodge for literal quotations from "Nature Study and Life," and from Robinson's "Principles and Practices of Poultry Culture"; to The Macmillan Company for quotations from Dr. Bailey's works, to Orange Judd Co. for quotations from Burkett's books, and to Doubleday, Page & Co. for quotations from Fletcher's "Soils."

I have tried to make agriculture teachable. That there is general dissatisfaction with our present text-books in agriculture, any one who has made a study of the matter admits. This book is intended for the common school teacher and therefore I have written largely in the terms of the psychology and educational philosophy with which teachers are familiar. I shall be pleased to hear from those who use the book.

I dedicate my book to the boys and the girls in the country.

Arthur D. Cromwell.

West Chester, Pa.,
February, 1915.

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Ye shall know the truth and the truth shall make you free.—JOHN viii, 31.

The child is entitled to his scientific inheritance, to his literary inheritance, to his æsthetic inheritance, to his institutional inheritance and to his religious inheritance. . . . The moment that fact is stated in those terms it becomes absolutely impossible for us ever again to identify education with mere instruction. It becomes absolutely impossible for us ever again to identify education with mere acquisition of learning. . . . When a child has entered into his inheritance . . . physical, scientific, literary, æsthetic, institutional, and religious, then we use the word culture to signify the state that has been attained.—NICHOLAS MURRY BUTLER in "Meaning of Education."

The well-being of a people is like a tree, agriculture is its root, manufacturing and commerce are its branches and its life; if the root is injured the leaves fall, the branches break away and the tree dies.—A CHINESE PHILOSOPHER.

We are told that the psychological definition of education is barren and formal—that it gives us only the idea of a development of all the mental powers without giving us any idea of the use to which these powers are put. On the other hand, it is urged that the social definition of education as getting adjusted to civilization, makes of it a forced and external process, and results in subordinating the freedom of the individual to a social and political status.—JOHN DEWEY in "My Pedagogical Creed."

AGRICULTURE AND LIFE

CHAPTER I

EDUCATIONAL AIMS

A Definition of Education Needed.—Just now, as we pass from the old idea of education for culture to the newer conception of education for vocational training, we feel more than ever the need of a satisfactory definition of education. A good definition would enable teachers to see more clearly their aim. But a satisfactory definition of education is hard to make. This is so because human life is complex and the aim of man is an ever-advancing one. Then, too, confusion comes from our failure to distinguish between education and schooling. The school is one of the institutions by means of which the process called education may be forwarded. When the home or the church changes or drops a given line of activity, there may be ground for difference of opinion as to whether the school should take it up. But there is small room for doubt as to the benefit that comes to a teacher who gets as large and full view of education as is possible. For as some one has said, "Men are really great in proportion as they act from the whole instead of from a part."

Aim of Man Varies.—In one age, we find discipline the dominant aim in education, then with the coming of Rousseau the aim shifts to the development of natural tendencies, but as Pestalozzi becomes popular, the idea of cultivation of the mental faculties becomes the aim of the great educators. After the theory of evolution is discovered, men begin to advocate the development of the scientific mind as the end and aim of education. And as evolution is supplemented by the development of sociology, the idea that education is for social service finds favor. These different views of education are not each abandoned for the next but each one leaves a valuable contribution.

The History of Education Gives Many Definitions.—The history of education gives us some three hundred different definitions of education, each by a great man who, like each of the

blind men viewing the elephant, sees it from one stand-point only. To Plato, education meant spiritual growth; to Aristotle, preparation for citizenship; to the early Christians, preparation for church life; to Bacon and the scientists, education means preparation for the enjoyment of scientific discovery; and to Spencer, education means preparation for complete living.

Dr. Davidson made popular the idea that education is *conscious evolution.* Dr. Butler emphasizes the idea that education is giving one his *racial inheritance.* Dr. O'Shea argues that education is *adjustment.* Others claim that education is making one *efficient.* One teacher dubs education as, "learning to read, write, and cipher while gathering a smattering of geography, history, physiology, science and literature."

A New Definition.—Undoubtedly the old aim of education for culture is waning and the newer aim of education for vocational training is gaining. It seems to me that we need education for both culture and vocational training. Keeping both aims in view, let us see if we cannot put together some of the theories as to what education is and out of the synthesis get a definition which will serve as a guide for teachers of to-day. With this in mind, we say: *"Education is the process of making one conscious of his racial inheritance in order that he may be better adjusted and of more efficient service to his fellows."*

To this objection may be made that, as with the definition, "Education is preparation for complete living," it gives us no idea of how one is to be educated. That is answered in the following pages of the book, so far as I understand what agriculture can be made to do. Again it may be objected that the definition, "Education is the process of making one conscious of his racial inheritance in order that he may be better adjusted and of more efficient service to his fellows," does not tell us to what he is to be adjusted. Of course we mean adjusted to his environment and at the same time gathering power to change that environment where it may be changed to his advantage.

Now taking one or all of the foregoing definitions of education, let us ask ourselves what power or possibilities have the study and practice of agriculture to help toward the desired end? Has the study of agriculture an educational value equal to or superior to that of other studies found in the common schools, the high schools and the colleges?

Agriculture and Life.—This book is the best argument that I can give to prove that agriculture helps one to live the freer, broader, deeper and more helpful life. It needs no argument to prove that the study of agriculture helps one to make a living not in the selfish, sordid, commercial sense where one profits by the loss of another, but in the higher social-service sense which the Master had in mind when he said, "He that loseth his life shall find it. Do unto others as ye would that others should do unto you." Luther Burbank puts the thought beautifully when urging more men to stay on the farms and take up plant breeding. He says, "And thus with better fruits, nuts, grains, and flowers will the earth be transformed and men's thoughts turned from the base destructive forces into the nobler productive ones, which will lift to higher planes of action toward that happy day when man shall offer his brother, not bullets and bayonets, but richer grains, better fruits and fairer flowers."

Agriculture Enlarges Consciousness and Helps Adjustment.—Throughout this book there runs the thought that the study of agriculture enlarges consciousness and enables one to see much in what now appears little. Since man must live by the sweat of his brow and be housed, clothed and fed from the products of the soil, and since the amount of land is fixed while population is increasing, it needs no argument to prove that the study of agriculture enables one to become better adjusted to his environment and gives power to adjust environment to self. Education for culture is a noble ideal, but it is useless to talk of higher culture for the great mass of humanity until they are better housed, fed and clothed, and until they have surplus leisure and are taught to use that leisure rationally. As Mr. Roosevelt says, "The hard materialism of our frontier life is now giving way to a harder materialism" where wealth is grasped for emulation and where money is spent lavishly for things that are destructive of human good. I believe that I show in the following pages how agriculture may be made to do its part toward giving us higher ideals while giving us more food, shelter and clothing. Our civilization rests on agriculture and we must learn to gain culture through agriculture or go without culture for the masses.

Agriculture and Our Racial Inheritance.—From one viewpoint education is giving a child his racial heritage. This idea

was at the foundation of our American public school system. In 1647, the Massachusetts colony established a system of schools, "in order that learning may not be buried in the graves of our fathers." And yet we let young girls begin teaching unconscious of the fact that there are such educational principles as that children learn most readily and remember most clearly when they value that which they are learning, that the natural interests of a child should influence the course of study, that children learn and retain most easily when the words which they read and spell are symbols of what they recently did, saw or experienced, that we respect and love, in our later years, what those whom we considered above us respected and loved when we were children. Early interests condition the will.

Not only in pedagogy, but in agriculture as well, does the law hold that unless we give a child his racial inheritance, "threescore years and ten" the knowledge of to-day will be buried in the graves of our ancestors. With the death of every elderly individual there is slipping away from us knowledge to be gained again, if gained at all, by costly experience. Agriculture is necessarily a localized industry. Elderly people have gathered much valuable information as to the time to plant, the best varieties of fruits, grains, vegetables, the relative value of one line of farming over another, etc. They have paid heavily for their information as to when to gather the crop. They had to lose a potato crop or two in order to learn when the danger time comes. It is one function of education to get that information into the consciousness of the young. There are those who tell us that the home should do that. We answer, the home does not do so and with our shifting population it is doubtful if the home can do so. The booklet work described in detail in another place offers a chance to convey this localized information. And the booklet work offers a place for conveying the information from the specialists whose function is described in the next paragraph.

The Agriculturist and the Specialists.—Many of the large corporations employ expert men to gather information and to convey that information to the foremen and the laborers, for the improvement of the business. One of the large machine companies has an expert to weigh every part of each machine and

then to test its strength in order to see if the weight cannot be reduced without endangering the strength and durability of the machine. Just so the farmers have an expensive, unless rationally used, experiment station system, to gather information of vital interest to the farmers. Is it right that the farm boy be allowed to become a man ignorant of this information? Without the help of the experts, he cannot buy this information with less than half a life of costly experience. Diseases of plants, dangerous weeds and how to eradicate them, the food value of different feeding stuffs, the effects of breeding in different ways, or with different crosses, improved plants and animals, commercial fertilizers, and a host of other things are carefully investigated at these experiment stations. These reports are given in government and experiment station bulletins, free to the people whose taxes pay for both the experts and the publication of the bulletins. These bulletins and the reading of some of them should become an organic part of every school having farm children in it.

Mr. Roosevelt put this matter tersely in his Utica speech: "One reason why the great business men of to-day have gone ahead, while the farmer has tended to sag behind, is that they (the business men) are far more willing to profit by expert knowledge—the knowledge that can come only as a result of the higher education. From railways to factories no great industrial concern can nowadays be carried on save by the aid of a swarm of men who have received a high technical education in chemistry, in engineering, in electricity, in one or more of a score of subjects. The railway man does not ask the college-trained experts to tell him how to run his business, but he does ask numbers of them each to give him expert advice. In just the same way the farmer should benefit by the advice of the technical men. During the last half century we have begun to develop a system of agricultural education at once practical and scientific, and we must go on developing it. And after developing it, we must use it."

The New Agriculture.—No one claims to be fully conscious of the ultimate outcome of the movement introduced into American life which has given us what we call the New Agriculture, which makes farming an applied science. Few even among educators are conscious of this new awakening and of the handi-

cap with which one will start in life who was not in his early years put into possession of this spirit, the technic and the accumulated information of the specialists and of preceding generations. Few are conscious that the teachers in those States where agriculture is taught in the schools are inculcating in the young a love and confidence in their State which means much for the future; while in those States where little has been done along the line of teaching agriculture, the people are leaving faster than the natural increase and immigration together can replace their numbers. But we are becoming conscious of the fact that in rural districts where agriculture is not taught, there is growing an ever-widening breach between the school and the rural home.

This growing separation between the school and the home comes from two things: First, the teachers, being unconscious of the New Agriculture, hold farmers and farm life in contempt and by their incidental remarks, their lack of interest and their inability to draw illustrations from anything but books and town, are spreading a desire for town life; and in return the teachers are gradually inculcating in the minds of educated people who live in the country an utter contempt for the poor pedagogue with limited capacity to learn from nothing but books. Our schools are "filled with uneconomic women and ease-loving men." The Country Life Commission says, "School-teaching is burdened with tradition." The second cause for the growing gap between some homes and some schools is the fact that the home itself has changed. In the old home from which both teacher and pupils came, all were taught to do many things. Now we are becoming over-specialized and hence ignorant and unappreciative of what the other fellow is doing. What we in the United States need are the many-sided men and women who see the value in every good and can point it out in an interesting way. We need for an ideal "the child in the larger contact," as Drummond would say; or "the child of the many-sided interest," as the Herbartians say.

Agriculture vs. Nature Study.—It was the hope of those who introduced it that nature study would give us the child of the larger contact, and in many schools the so-called "Fundamental Nature Study" is doing all that we can ask, but in too many schools nature study has become a sentimental matter

dealing with trifles and always stopping just short of anything practical. Teachers need to be reminded that children in a rough way pass through the same stages as did the race; that man's human superiority is due largely to the development of hand rather than brain. This means that a child learns by doing, that he often does before he becomes conscious of what he is doing, and that in the lower grades the child should have life enriched with actual experience with simple and fundamental things of life; while in the high schools and colleges, the same pupil should have life enriched by science or classified knowledge. The race did not at first begin science with the microscope, or pick flowers and fruit to dry, press, stick on paper, poison, and finally "label with jaw-breaking, Latinized, polysyllabic names."

Much of our nature study is positively immoral. Every season our teachers send forth an army of youngsters to devastate field and forest of every vestige of native flower. While living in a small city, I had my flower bed looted daily by the children from the primary room who stole the flowers to take to their dear teacher. It was the common practice for the boys taking botany in a certain university town, to raid some one's yard each night, in order to get specimens for the class next day. And throughout the course not one word was said against the practice or about how to plant, propagate, and care for the plants; they were learning to analyze and classify flowers. Such practice makes one feel like the boy in the story. He was praying and, while doing so, his little sister tricked him on the foot with a feather, until he prayed, "Oh, God, excuse me just a minute, until I lick the dickens out of Annie.

Agriculture vs. Text-Books.—In the United States, we have become so infatuated with text-books and text-book teaching that we have lost all tendency to do original work. Everything is measured by the text-book. "Books," says Emerson, "are among the best of things, well used; abused, among the worst. . . . They are for nothing but inspiration. I had better never see a book than be warped by its attractions clean out of my own orbit." It is to be hoped that we can save the subject of agriculture from the text-book cripple. As Professor Bailey says, "Everything will depend upon whether this teacher can escape from text-book drudgery and the old four-walled laboratory method. Agricultural subjects are alive and they are out-of-doors

(Fig. 1); it is for this reason that many persons are looking to the introduction of these subjects to be a quickening agency in the schools." If a teacher cannot teach the subject, it is to be hoped that she will leave agriculture alone. But the fact is any bright young man or woman can teach something valuable in agriculture provided he or she becomes conscious of the fact that the natural interests of the children should be the guide.

Courtesy Iowa State College.

FIG. 1.—Agricultural subjects are alive and they are out-of-doors. (Bailey.)

It must not be understood that we advocate that the teacher should not read books and bulletins on agriculture. She should read much, and one of the most important aims in teaching agriculture is to get the children to read and to introduce into their homes the bulletins of the State and the United States departments of agriculture. As a result of the teaching of agriculture in the public schools, the farm journals and the many excellent

books that are now appearing on every phase of country life and farm practice, should find a place in our rural homes, in our schools and public libraries.

Agriculture Gives Executive Ability.—It was not so much the information that the farm boy got as his many-sided interest and his intellectual and work-habit discipline that accounts for the leadership of the men reared on the farms. What in the present school course equals a good farm as a place to train the senses and the power of observation? The song of the bird, the chirping of the insect, the blight on leaf or flower, the crawling

FIG. 2.—The country child learns real things, the town child symbols.

snake, the light foot of the rabbit are easily understood by the delicately trained ear and eye of the farm boy. For him, each domestic animal has its language which tells of health or sickness. Sight and hearing and touch and smell are in constant use on the most varied of objects. But memory and imagination coupled with quick action are called for no less often. The breaking of a calf, sheep, dog or goat (Fig. 2), the driving of a team, the adjustment of farm machines, the planting and ripening of grain—all call for memory and reasoning coupled with quick decision and action. And then the power to work though the body be weary and the muscles ache or the power to be alone and

meditate—to develop these, what equals plowing, harrowing, harvesting, or husking corn, picking fruit, coffee or tending sugar cane? These are what make the boy from the country superior to the boy in the town. And yet, where is the school that allows this boy to enter with this splendid equipment of mind and body and not feel in disgrace because he is somewhat behind his town cousin in books? The country boy knows the real things, the town boy, the symbols as found in the books on arithmetic, geography, grammar, and history.

Fig. 3.—Country children acting King Arthur. The farmer needs vision and imagination stimulated by the early English writers.

Agriculture Makes Better Citizens.—The first attribute of a good citizen is the power and desire to make an honest living, therefore our schools should enable him to read with pleasure any book that will help him toward that end. But it must not be understood that we argue that the tiller of the soil should read books on agriculture only. The next attribute of a good citizen is the power or desire to use his leisure so as to become something better and nobler each day. The farm child is not to be shut off from the masters in science, art, and religion. The farmer needs the love of beauty and harmony that comes from contact

with Greek thought as revealed in Greek art and literature. He needs the love of order and obedience to law that come from loving contact with the old Romans. He needs vision and imagination stimulated by the early English writers (Fig. 3). He needs the power to adjust himself readily to human associates, which comes with an intimate knowledge of human nature as revealed in the classic dramas and novels. The farmer needs the inspiration and the broader and deeper outlook that come from reading the master poets of all the ages. No country is safe with a democratic form of government unless a large proportion of its people have their minds brought into contact and held in contact until they work with ease and pleasure on the productions of the masters. The key to history is in the conflict of different races. Other races are making valuable discoveries of which we may learn only through their literature. Unless a large number of our people read the foreign languages, some day "our children or our children's children will mourn for our negligence."

The human mind loves to gather from the experience of others, but it loves also to share its experience with others. Our public schools, by not offering an outlet for the pent-up longing in the breast of many a child, lead him to a dawdling sentimentalism. Not all children love to write. Some love to do. However, many a child who might be led to do something or write something of great value to his race, now sits around with a longing to win in athletics or to write something sentimental because these are the fields where he has most often heard of young people winning distinction. A few years ago, the editor of the *New York Independent* compiled the life histories of a number of Americans in different occupations. Of these people, only one was dissatisfied with her lot in life. She was the wife of an Iowa farmer. It was her desire to become an author, but since she lived on an Iowa farm, she thought that she could come in contact with nothing worth writing about. Poor, unconscious woman, surrounded by nature on every side and possibilities undreamed of! She might by learning and telling in an interesting way the life history of a single insect and how to control it, or the work of a single bird, toad, frog, snake, germ, blight, smut, or whatever it may be; she might by becoming conscious of it and its bearing on human life and by telling what she has

learned in an interesting way, do her fellow-worker more real good than has any writer of fiction or drama. If this poor woman had been led to see, in her public school days, that in the comparative study of animal intelligence we have one of the most promising fields for explaining some of the deepest problems in human conduct, she would have found her work of "driving the calves across the road and leading the colts to water" anything but the drudgery which she so laments. If she had been wakened

Fig. 4.—Domestic science in the high school. Those who have seen domestic economy introduced into the high schools have seen girls awakened to possibilities of human service.

to the possibilities of introducing fruit and vegetables of better cooking or keeping qualities, she would have found her little kitchen and cellar anything but uninteresting. Those who have seen Domestic Science and Fundamental Nature Study introduced into the grades and Elementary Agriculture and Domestic Economy as living, out-of-door subjects introduced into high school (Fig. 4), have seen young girls awakened to possibilities of human service in the kitchen, and boys awakened to possibilities on the old farm, undreamed of while they were chasing

books for an ideal. In this connection I wish that the teacher would read Markham's "Man with the Hoe," and ask herself:

> Who made him dead to rapture and despair,
> A thing that grieves not and that never hopes,
> Stolid and stunned, a brother to the ox?

If there be such among us, or if we develop a country peasantry as low and degraded as that of Europe, at the doors of our public schools part of the shame and disgrace must lie. But we must not hope to make life on the farm all joy and pleasure. One of the unfair comparisons so often heard is that where the average man or woman on the farm is compared with the rich in town. The only fair comparison is to compare the life of the farmer with the life of the laborer in town. It is often claimed that there are more women in proportion to population who go insane on the farms than in town. The superintendent of the Iowa hospital denies this but says that there are more of those who were reared in town and then move to the country, for which they were unprepared by previous education and training. I quote the following from Dr. Pauline E. Leader, physician at the Clarinda, Iowa, hospital. Speaking of this woman who came from the city or town, she says: "She does not realize until late that she has been burning her taper at both ends. She begins to weaken, she is slow with her work, she tries to hurry; confusion takes the place of order; she begins to worry, and worry is to work what discord is to music; little things annoy her, she becomes irritable, begins to feel depressed, peculiar ideas take possession of her, and the result is mental unbalancing. The short, busy season will not always permit the woman on the farm to systematize or plan her work so that there will be no more than she can easily accomplish in one day, so that mind and body may have a relaxation or rest some time during the day. She often arises tired and weary in the morning, plods along all day, walking the treadmill of daily routine, for she is mother, housekeeper, dairymaid, washerwoman, and fills various other places indoors, while she is often gardener, milkmaid, and chore boy outside, and often with all this she is preparing for the coming of the stork; race suicide is no part of her thought or creed. She works on into the late hours of the night, for each day brings more than its own work, and before the tired

muscles and nerves are relaxed and renewed by sleep, she is up and at the same or similar work again.

"She never takes time to rest and drink in the beauties of nature all about her, to watch the sunrise, to listen to the robin's song or the blue bird's call, to study plant life, etc. Her work is never done. She never reaches the end of her goal. The farmer woman usually has a double worry, that of her own and that of her husband who often confides all of his cares and worry to the tired brain, thoughtless of the psychic suicide he is helping his wife to commit. Hence she helps her husband worry over the crops and stock, fearing lest the season be too dry or too wet for the oncoming crops. Thus it is true that 'evil in this world is as oft begot by want of thought as by want of heart.'"

What are our school teachers doing to help this noblest of the world's mothers? Is there anything in the arithmetic or grammar, the reading or composition lessons that sends the children home more appreciative of mother's and father's efforts? Is there anything in the school that gives the children inspiration to go home and work off some of their surplus energy helping to care for the garden? What are the children getting in school that sends them home with joy to talk over with mother the life of the birds or the beauties of animals and plants? Preaching is important, but I would rather be a school teacher who sends her children home to inspire and cheer mother, than be the preacher who thrills the people of a great cathedral.

The Bread Basket and Universal Peace.—Then, too, for ages mothers have been bearing sons for men to shoot in war. Sixty per cent of the governmental revenues of a number of European countries goes to defray the expenditures for army and navy. In America we hear men arguing for larger appropriations for our army and navy. But really the most certain and secure national defence is to be found in the bread basket filled by the American farmer. English working people must eat. German laborers demand American breadstuffs. Let a boat loaded with American breadstuffs be crossing the Atlantic and we have the protection of the most powerful battleships of the nation for which that boat has cleared. Increased exportation of foodstuffs offers increased prosperity and happiness at home and increased protection and friendship of the nations abroad.

Twentieth century woman in her clubs must be made conscious of the power of better agriculture in America to help us to realize that happy day "when man shall carry to his fellow-man not bayonets and bullets" but more bread and meat and raw products for labor to work upon. Women on our farms must be made conscious that they and their families are part of a great organization and that in the last analysis the farmer is doing quite as much as any one to usher in universal peace.

The Economic Value of Agriculture.—In the preceding pages, I indicated some of the distinctively educational values of the study of agriculture. It now remains for me to give some of the economical, æsthetic, ethical and religious values as first outlined by Professor Hodge. Those wishing a fuller treatment of these topics should read Chapter I of Hodge's "Nature Study and Life," also pages 156 to 161 of Foght's "The American Rural School." The most significant thing in American history is frontier life, and the most significant thing in frontier life is the dead earnestness about making a living. If teachers wish to make their schools popular with the people, they must make them practical. And that means that the teachers must enable the children to become men and women able to make more money. And that in turn means vocational education, though, if rightly directed, there will be more to vocational training than increased earning ability. In a democracy like ours, people must be taught to find pleasure in the content of their work or the government is in danger.

If from the start the parents see that the children come home with renewed interest and enthusiasm for the farm and the farm work; if the farmers see from the first that the children come home with new and valuable information about pests and how to control them, or if they have learned to select better seeds, to select and take better care of the stock, and to be more economical of the feeding stuffs, agriculture in the schools will be popular, and money for the schools wherein it is taught will be given freely. The economic is not necessarily the highest value but it is basic. That was wise advice that Professor Holden gave to the progressive teachers in Page County, Iowa, when he told them to begin the work in agriculture by having the pupils learn to test milk and seed corn. When the farmers saw that the children had learned how to weed out the poor cows and the ears of corn

that would not grow, they had no objections to the other work done in agriculture. In teaching agriculture as in oratory the same rule will hold: begin with the highest motive to which your people will respond and then pass to a higher and a higher. Teachers of agriculture aim at "the universal diffusion of the maximum amount of the most important knowledge."

The Æsthetical Value of Agriculture.—Children have an instinctive love of the beautiful. In fact, love of the beautiful begins way back of the human race. The most superficial study of animals and plants makes it plain that their lives are largely shaped and controlled by influences that make for beauty. The beauty of shape and color in flowers is undoubtedly due to the choice of insects that are attracted by them. Even the odors are due to the choice of insects. The mating of animals has led to a natural selection that has given us the bright plumage and other colored parts, the heavy manes, the proud struts and the beautiful shapes of many of the animals. While this instinct for the beautiful is present in all normal children, it may like other instincts or tendencies be allowed to remain dormant until the child ceases to respond or get pleasure from the really beautiful. Much of our hard pioneer life has tended to crush out this instinctive love for the beautiful. And yet, strange as it may seem, the love for the beautiful is a very "practical" affair. When our farmers are more like the farmers of France and put up their farm products in neater, nicer looking form, their prices will rise rapidly. When their fruit is better sorted and boxed, when their butter looks more attractive, when their eggs are graded as to form, color, and size, when they bring their milk to town in more attractive cans, the amount consumed and the price paid will be greatly in favor of the farmer. Even a beautiful lawn and well-kept buildings often win a farmer city customers who pay much more than the regular market prices.

The first half of the twentieth century is the critical period æsthetically for many States. The buildings and other temporary improvements of the pioneers are to be replaced by permanent improvements. If our schools turn out a generation sensitive to the beautiful, we need have no fear but that the beauty of the country will give way to greater beauty of the permanent home makers. Æsthetic culture will teach the country folk to love their open skies, their beautiful groves and open

prairies, their wonderful landscapes with their golden harvests, their woods and their orchards. If we teach the children to appreciate the beautiful, they will be content to dwell in the country, and when they are away, they will long to return to the beauty, the quietness and contentedness of the country. But we cannot make children love the beautiful by talking about it and nothing more. To love the beautiful, we must study, and dig, and plant, and compare, and hold communion frequently, and for a long time. Nothing short of living consciousness of the beautiful will make us love the beautiful.

The Moral Value of the Study of Agriculture.—If we teach children to become men and women who make more money, and if we teach them to love the country for its beauty, then we teach them to desire to build up the country, and hence the economic and the æsthetic values of agriculture have an indirect bearing on the social or ethical development of a people. But with agriculture in the school there will come more property that belongs to the pupils and ownership leads to a respect for the ownership of others. We learn to love trees and lawns and birds and pets and flowers and fruits by having and caring for these things ourselves. Vandalism, like other forms of crime, is usually due to ignorance or to short-sightedness. The melon patches are looted by those who never raised melons, the fruit is stolen by those who do not grow fruit. The birds are killed by those who do not have orchards infested with insects or those who do not know that a single downy woodpecker, eating but one codling moth a day, for the hundred and fifty days between April and December, will save $585 worth of apples from becoming wormy. The weeds are allowed to grow by those who have no garden or pastures to protect. Destruction of injurious insects takes on a new meaning when one has a pet or plants that are being injured. Not being told but doing, not seeing but owning, gives us respect for the property and the property rights of others.

The Religious Value of the Study of Agriculture.—If one can make a better living, find more beauty, and do more to help others, he is not far from leading a religious life. No human being can live in loving, first hand contact with nature without loving its author. It is natural to pass through nature to God. The love of nature soon leads to the love of God. Those

who hold communion with nature soon hear the still small voice and this, as Foght says, "Offers the teachers manifest opportunity to take advantage of the 'still voice' of nature to reach the inner recesses of the child's soul to instil there a love for well-doing in looking after the happiness of God's created things." If a child is correctly taught, he learns to read nature as a "message from God, fresh written every morning." But in many instances where we have not taught agriculture, the farmer in his haste to get rich has forgotten to learn to live, he has not learned to love nature, his work or his God.

QUESTIONS AND SUGGESTIONS

1. Why do teachers need a definition of education? A new definition?
2. Which aim of education appears to you best? Why?
3. How do you agree with the function assigned to books?
4. What are "booklets"? What are the characteristics of a good "booklet"?
5. Is there a New Agriculture?
6. Are our leaders coming from the farms or the cities?
7. Has vocational education anything worth while for the schools of to-day?
8. Which is the better place in which to be reared, the city or the country?
9. Summarize the ways in which agriculture makes for life.
10. What is our Country Life Problem?

References.—Davidson, A History of Education; O'Shea, Education as Adjustment, also Social Development and Education; Butler, The Meaning of Education; Gillett, Vocational Education, also Rural Constructive Sociology; Bloomfield, Vocational Guidance of Youth; Dopp, The Place of Industries in Education; Dewey, The School and Society, also My Pedagogical Creed; Betts and Hall, Better Rural Schools; Bulletins of the United States Bureau of Education and the Department of Agriculture; The Report of the Country Life Commission; Bailey, The Country Life Movement, also The State and the Farmer; Field, The Corn Lady; Carney, Country Life and the Country School; Plunkett, The Rural Life Problem in the United States; Butterfield, Chapters in Rural Progress.

We are beginning a new agriculture, not continuing an old.—L. H. Bailey.

And the Lord God took the man and put him in the garden . . . to dress it and to keep it . . . and God said . . . Be fruitful and multiply, and replenish the earth, and subdue it; and have dominion over . . . every living thing.—*Genesis.*

The vast possibilities of plant breeding can hardly be estimated. . . . These vast possibilities are not for one year or for our own time or race, but they are beneficent legacies for every man, woman, or child who shall ever inhabit the earth. And thus with better and still better fruits, nuts, grains and flowers will the earth be transformed and man's thoughts turned from the base destructive forces into the nobler productive ones, which will lift him to higher planes of action towards that happy day when man shall offer his brother, not bullets and bayonets, but richer grains, better fruits and fairer flowers.—Luther Burbank, quoted in Hunt's "Cereals in America."

CHAPTER II

SEED SELECTION AND PLANT BREEDING

Educational Importance of Seed Selection.—Perhaps nowhere else can the children be interested more easily than in the selecting of superior garden vegetables. In France, we are told, they have the finest vegetables in the world, and this is so because they practise the most careful seed selection. And strange to say, in France the children are taught to select and prepare the seeds for the garden. With us it is very different. The American gardener sells the superior vegetables, especially the earlier ones, and then he sells to the seed houses the seed from those that were not fit for market. A strange "survival of the fittest" we practise! This subject of better fruit and better garden vegetables for the farmer's own table has a far-reaching sociological meaning. We shall never make farm life what it should be until we enable the mothers on the farms to have a better time than do mothers in towns and cities. This means that the women on the farms must live in houses with modern conveniences and have plenty of first-class things to cook. More fruit and better garden vegetables (Fig. 5) would stop the longing of many a woman to go to town to live. Enable the mother on the farm to become conscious that she is free from her town sister's nagging worry as to where the next meal is coming from; make her conscious that she lives in a good house; that she has more vegetables, fruit, flowers, sunshine and birds; make her conscious that the growing of vegetables has a far-reaching educational significance and you will increase her desire to "stay on the old farm a while longer." A woman in the country who has these advantages and who is conscious of them will not "be in a hurry to go."

Teachers should remember that both the psychologists and the sociologists place great emphasis on the importance of the *development of forethought*. Nothing found in the present school course equals seed selection for the development of forethought. The power of forethought has been said to be the faculty that

most clearly differentiates man from the lower animals and civilized man from the lower races.

Seed Selection for Fall or Spring.—Seed selection makes an equally good subject for those who begin the work in September and for those who begin to teach agriculture in the spring, though the hot-bed, the hot-house (Fig. 6), and the school garden are the logically and seasonably correct subjects for the work in the spring. If seed selection is begun in the spring there may

Fig. 5.—Make the country woman conscious that she has vegetables, flowers, sunshine, that these have far-reaching educational significance, and you make her happy to "stay on the old farm a while longer."

be discussions of where the best seeds are to be obtained and of the work of our seedsmen who up to this time have been our principal plant breeders. Having secured the best seed to be obtained, and having planted it on good ground and by the most approved methods, the teacher may next lead the children to watch the school or home garden. As soon as the first vegetables appear the best should be marked and saved to bear seed. The marking is done by setting a stake on either side of the best appearing radish, lettuce, or whatever the plant may be. This

vegetable may be watched through the season, though if it be lettuce, radish, or some other vegetable which matures its seed the first season, all that is necessary to do is to cultivate it with the others, and let it stand to mature seed. But if it be cabbage, beet, carrot, parsnip, turnip or some other plant which does not go to seed the first season, then it must be pulled in the fall, packed in damp sand and kept over winter in a cool place. The next season the root (if cabbage stump or stalk) is to be replanted and let go to seed. The cabbage head may be used and only the stem and roots wintered over.

While doing this work many questions will arise. How to plant, how to cultivate, how best to select and preserve seed, how to fertilize, what is the best kind of soil, and others will be asked. These are good; they come from the instinct of curiosity. They are of most educational value if answers can be put off until the proper time and each answered as answers are needed.

Courtesy Double Glass Sash Company.

FIG. 6.—The hot-house.

Propagation by Roots and Cutting.—During the fall months there is much to do on the farms, with plants that are propagated from roots and cuttings. Cuttings of grape vines with four buds on each may be placed in the moist ground with the butt or large ends up. It is best to have them slant about forty-five degrees to the earth surface. They should be covered with moist soil and left until spring, when they are to be dug up and stuck in the ground, large end downward, and far enough to have the soil cover the two lower buds. This gives two buds for roots, and two for leaves. Young trees may be taken up in the fall and heeled in for the winter or for early spring planting. Others may be taken up and heeled in moist sand in a box to be stored in some convenient place where it may be gotten at in February or March. It is during the slack times of these months that

the *grafting* (Fig. 7) is done. But before I tell how to graft, I need to tell how to start an apple tree. We must gather the

Courtesy Wallace's Farmer.

Fig. 7.—Tomato grafted on to a potato.

seeds from the apple and plant them in a window box, a hot-bed or hot-house before they become thoroughly dry. We may put

them in moist sand and set the box out where the seeds will keep cold until spring and where they will freeze so that the little plant may the easier get out of the hard shell. However, many of the apple seeds will sprout at once if placed in good soil kept well dampened in the window box. One teacher used a chalk box for starting her apple seeds. The apple seed has come from cross-pollination and hence we are not sure just what parents the little tree has, that is, we do not know what kind of apples it will bear. Now to insure its bearing the kind of apples that we want, we graft a limb of some known variety into the stump of the little

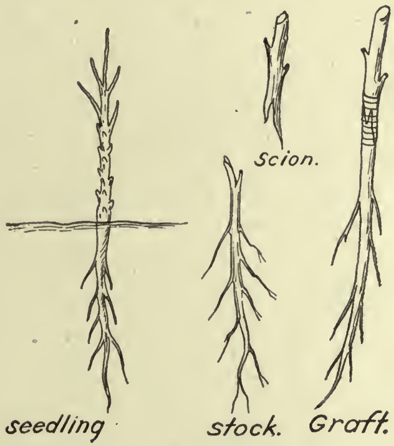

FIG. 8.—Tongue-grafting.

tree (Fig. 8). For this work in grafting it is necessary to know something of the *cambium* layer. This is the part of the dicotyledonous plant producing growth. We call it parenchyma (paent) tissue. It is from the cambium layer that the fibrovascular bundles develop. These fibrovascular bundles are the sap pipes for the plant. They carry the sap up and down to nourish the different parts or to be mixed with carbon and more thoroughly digested in the leaves. This cambium layer is the white layer just under the bark. It is the part that when watery enough enables us to slip the bark off to make a willow whistle.

When grafting, we must be sure that on one side at least, the cambium of the stock and the scion (branch) just exactly meet.

Then we put on grafting wax to keep out bacteria and the spores of fungous diseases. We cover the wax with cloth or corn-husks to keep it in place until our graft is "set." For fuller directions, see Farmers' Bulletins 113, 157, or 408.

If we grow a peach tree, we plant the seed as we did the apple, but instead of grafting, we bud the peach. This is easier for all that we have to do is to cut off a leaf bud and slip it under the bark of the tree. Of course we must make cambium meet cambium as in the case of the apple graft. We must bind up the wound in some way so as to keep our bacteria and the spores of diseases. After our bud is set and begins to grow, we cut off the little tree above the bud unless we wish it to bear more than one kind of peaches. Then when the proper time comes we must move our little trees from their nurseries to the places where we wish them to stand when grown. This process of moving we call transplanting. Most farmers buy their nursery stock and hence transplanting is for most farmers more important than budding or grafting. It is becoming more and more common to find one of the redirected schools doing the plant-breeding work. These schools are able to have little nurseries in connection with their school gardens and are able to furnish all of the trees that the farmers of the district need to replace trees in their orchards. There are

TEN RULES FOR TRANSPLANTING

1. Make the holes large enough to receive the roots easily.
2. Make the holes deep enough so that the soil will come just above the swelling made by the grafting.
3. Unless you are transplanting forest trees, put a shovel full of well-rotted manure in the bottom of the hole.
4. Take up the little trees with the least possible harm to their roots.
5. Trim off with a sharp knife all mangled and broken roots.
6. Cut off enough of the branches to balance the injured root system.
7. Dip the roots in water before planting. The roots should be kept damp; this may be done by coating them with wet clay soil.
8. If the soil is dry, add water with the soil until the hole is about half full.

9. Pack the dirt solidly around the roots of the little tree. The soil does not need packing at the top.

10. If transplanting in sod or lawn, do not heap the dirt around the tree but instead leave a basin to catch water and avoid danger when mowing.

Pruning is another important subject but I must leave it to be learned from Farmers' Bulletin 181, Sears's "Productive Orcharding," Chapter X, or other books on horticulture. Fig. 9 is a good example of a low-headed, well-pruned tree.

From "Productive Orcharding" (Sears).

Fig. 9.—A low-headed, five-year-old peach tree. This tree was headed at six inches.

Seed Envelopes and Cards.—During September and October, whether the seed work was begun in the spring or in the fall, the children should be induced to gather the seeds, thoroughly dry them, and then put them away in paper sacks, where mice and insects cannot get at them. Later the children of some of the grades may prepare envelopes for the seeds. The envelopes may be obtained from seed houses, or ordinary correspondence envelopes may be used. On these envelopes the children are to write the name of the plant from which the seed came, variety if known, whether early or late, time of planting, best kind of

soil, and as much of how to plant and cultivate as space will permit. These envelopes may be pinned or stapled on to large pieces of stiff pasteboard and used for part of the school exhibits.

Booklets Correlate with Reading, Writing and Spelling.—The pupils should start booklets on plants, plant breeding, seed selection or some special phase of the study. They may be most of the school year making the booklets, but whenever they get a page good enough to keep, they should have a place in which to keep it. The booklets may contain the history of the plant,

Fig. 10.—Agricultural booklets. Booklets correlate agriculture with drawing, writing, reading, and spelling.

its value for food, how to breed it, how to cook and prepare it, and how to keep it. A list of the different varieties grown in that section of the country, with the relative advantages and disadvantages of each, makes splendid booklet material. The booklet work may be done as part of the English, writing, reading or spelling lessons. It should not be done as part of the work in agriculture to the exclusion of the work that deals with things out-of-doors. Covers may be made for the booklets (Fig. 10) as part of the work in drawing. The farm journals, the catalogues of the seed houses, and the nurseries furnish illustrations, pictures, letters for lettering, and valuable suggestions for sub-

ject matter. Sometimes it is necessary to use some of the government bulletins for pictures or illustrations; these do not need to be destroyed but copies of the illustrations may be made. This booklet work should make the child feel that there is much he should read. The booklet work should make him desire to write better, to spell more accurately, to acquire a larger and more accurate vocabulary and a better sentence structure. These are necessary to enable him to prepare a booklet of which he may be proud as he sees it in the school exhibit on commencement day, at the fall festival and fairs. A full discussion of booklets and how to make them is given in Chapter XV. The splendid correlation table given for corn, in Chapter XV, outlines the work for each month in the year, both indoor and outdoor.

Where there is an old gardener who is an interesting talker it is often advisable for the teacher to get him to come to the school-house, or, better, take the pupils to his place, and have him give the children a talk on growing some particular vegetable, how to prepare the seed-bed, plant and cultivate, selection and care of seed, or any one of a hundred interesting things for children to learn. His talk, or talks, make valuable material for English lessons and then for a page or two of the pupil's booklet.

Some government bulletin or some good book may be brought from the library and one of the brighter or more interested pupils allowed to read what it has to say on the particular plant under discussion, and then this pupil may report to the class or the school, and here again we have material for composition lessons and perhaps another page or so for the booklets. The child may talk of these discussions at home, and from that some parent may want to see the bulletin or booklet and thus home and school are drawn closer together and a little child is leading them.

Correlate the Work with Geography and Botany.—When the history of the plant is being looked up, for a page in the booklet, the teacher should not miss the opportunity to have the pupil apply some of his work in geography. If he has learned to use maps, he will easily be able to point out on the map the place where the plant originated and, if he is deficient in this ability to use maps, here is his opportunity to become somewhat more proficient. If the teacher has studied botany or is willing to look the subject up, she may do some valuable work in classification of roots, underground stems, tubers, and so on. Children

should learn to call things by their right names. Then, too, the flowers, the parts of the flowers and their right names may be taught to children of the lower grades. The teacher should use the names and teach the children to call the outer row of green leaves, or scales, bract or calyx, as the case may be. The colored row should be called corolla if it is the corolla. The stamens and pistil and their parts—anther, filament, style and stigma—should all be called by their right names. The characteristics and names of six or ten of the leading families should be learned by pupils before they reach the high school. They should learn to name and recognize the representative members of these families. Farmers frequently listen to lectures from which they derive much more benefit if they have some knowledge of how plants are classified. Rotation of crops should require a change of plant families. Corn, wheat and oats are members of the grass family (*Gramineæ*) and, while a succession of these three crops may enable the farmer to handle his labor and soil to better advantage, yet there is no benefit from a succession of the different members of the grass family to be compared with the benefit which a farmer gets if he follows members of the grass family by members of the pea, or *Leguminosæ* family. The rose, the *Umbelliferæ* (carrot), the *Cruciferæ,* and the *Compositæ,* the nightshade or *Solanaceæ* families are families with which a farmer has much to do.

Species and Creationism.—Then, too, life will mean more and when the boy becomes a man he may the better coöperate with the forces of nature if his school has put him into possession of the accumulated knowledge of the ages as to how his plants and animals came to be what they are. The first botanists had little idea of evolution and hence tried to classify plants on the theory that species of both plants and animals were created separately and were distinct from the beginning. Linnæus voices the belief of his age and of former ages, when he gives us his now famous sentence, "We reckon so many species as there were distinct forms created in the beginning." In 1691, Camerarius discovered the fact that plants have sex, and in 1719, Thomas Fairchild, an English gardener, produced the first recorded hybrid. During these years and the following years, men worked out elaborate systems of classifications for the plants, on the theory of special creations. They reasoned that

since plants were created distinct, therefore we may classify them into species the pollen of which will not fertilize or at least will not enable the plant to mature seed which will grow. Hence species theoretically stands for plants which we cannot hybridize. But as was to be expected, the early botanists made many mistakes, and hence the term "species" helps us little in determining what will and what will not hybridize.

In the beginning of the nineteenth century, Lamark advanced the theory that living things have descended from a common ancestor. He assumed that the influence of the environment was able to change the characteristics of plants and animals. His evidence was not sufficient to enable Lamark to convince the people of his day and hence the theory of special creations or *Creationism*, was very generally held until 1859, when Charles Darwin published his "Origin of Species."

Evolution and the Origin of Species.—Darwin's evidence for proving evolution was so abundant and his handling of it was so masterful that it has remained unshaken. His being the last "in the line" enabled him to receive more popular credit than he deserved, so far as the discovery of the theory of a common descent is concerned. Darwin proved that the origin of species in the past was the same as the origin of new varieties in the present. Of course men objected on the ground that we do not observe actual, specific changes of species. To meet this objection, Darwin advanced the theory that the changes are so slight that we fail at any given time to notice them. But they are accumulative, and hence in ages they become very noticeable. But to this physicists and astronomers objected on the ground that the time for the creation of our varied plant and animal life would be too long. Lord Kelvin and others by figuring on the radiation of heat from the earth, on the deposits of calcareous rocks, on the amount of salt in the sea, etc., were led to object that the time for the evolution of all species from a common ancestor by the slight changes assumed by Darwin was entirely too short. But though there were objections to Darwin's explanations, still his theory of a common descent had come to stay. To-day the leading scientists believe that. Then, too, Darwin did much to establish and explain variation. He found some variations for which he could not account and he called such "sports." He gave us the phrase "natural selec-

tion," to which Spencer added "survival of the fittest," both very useful intellectual tools for the husbandman. And Darwin made it necessary for us to reclassify our plants if not to discover a better explanation for the way one species comes from another.

Darwin also gave us a new scientific age in which we demand "sufficient evidence." This means that we ask the scientist to give us a cause big enough to produce the result which he claims for it. Darwin did much to bring that happy day when people in the country may live in the "certainty of science." Country people are more dependent upon nature than are town people and hence country people should know more of life and death, of lightning and wind, and of how things come about. Much of the unhappiness in the country comes from superstition. For superstition we must substitute the "certainty of science" or the demand for sufficient evidence. Then, too, the farmer is ever working with variations, natural selection and artificial selection, and he is trying to secure the survival of the fittest. But, thankful as the farmer should be to Darwin for the ideas and the phrases and evidence for common descent, survival of the fittest, natural selection, and the age that demands sufficient evidence, he has a right to demand of his school—especially of his high school—that it put him into possession of a better explanation for much of the phenomena which he observes around him.

Variation and the Constancy of Species.—The leading scientists of to-day, especially the plant breeders, are at a loss to find illustrations of variations in the direction of evolution. They find that plants are changed by dropping something, such as part of their color, or the width, length, or texture of an organ. But this is apt to be reversion instead of progression. The plant breeders who have been dealing with thousands upon thousands of plants have very generally come to believe that species may, like individuals, have their birth, lifetime and death, that the struggle is between species and hence plants become extinct by species and not by individuals. This belief is strengthened by the discoveries of the old beloved teacher of mathematics, Gregory Mendel.

Mendelism.—Mendel was monk and abbot of the monastery at Brünn. He bred and crossed peas and carefully tabulated results, and from his work in his little garden we have some of

the most helpful facts made known in modern times. Mendel found order in nature. He found certainty where others could see nothing but uncertainty and disorder. He found mathematical order in heredity. After eight years' work he published his observations in the *Proceedings of the Natural History Society of Brünn.* But his account of his experiments attracted very little attention until rediscovered in 1890 by Hugo DeVries and others.

Mendel gave us the laws of heredity. By use of Mendel's laws, we learn that we get from a plant just what we put into it. Some of the scientists are led to believe that there is no variation at all but just possibilities of different combinations of factors.

To describe Mendelism, terms similar to those used by the chemist were necessary and hence the terms *unit-characteristics* and *factors* were coined. By unit-characters we mean certain parts of plants or animals which are inherited as units; for example, color, form, size, horns, hairs, open or closed fibrovascular bundles, bark, shape of leaf, etc.

If we were breeding timothy (Fig. 11), silo corn or wheat, we would want to know and to understand the hereditary tendencies of such unit-characters as:

Heads:
- Long or short.
- Dense or loose.
- Large seeds or not.

Leaves:
- Long or short.
- Wide or narrow.
- Thick or thin.
- Smooth or hairy.
- Rust resistant or not.

Stems:
- Tall or short.
- Stout or slender.
- Stooling or not.
- Internodes short or long.

Habits:
- Early or late.
- Low down or erect.
- Disease resistant or not.

One of the corn club boys made very good use of his knowledge of unit-characters. He knew that others had had difficulty in trying to get high protein corn to yield heavily. But he noticed that some ears have kernels which when in test give three to five rootlets of equal size while others give one large one and few if any smaller ones. From this he reasoned that by using his high protein corn and selecting for heavy rooters, he might get better yields. He won a trip to Washington over his competitors.

But the scientists soon discovered the fact that unit-characters are too complex. They resemble the compounds or molecules of the chemist. Breeders need a word that denominates the phenomena reduced to its simplest terms, and for that they adopted the name *factors*. Color, for example, may be yellow, red, blue, green or a combination. Hence in plant breeding we may be dealing with the yellow or the red only, and instead of calling it a unit-character we call it a factor.

Courtesy Penna. State College.

FIG. 11.—Differences in rust resistance of timothy plants.

Heredity.—What order did Mendel find? Others had noticed that the young resemble the parents and hence there is heredity. They had noticed that no two plants, parts of the plant or animal are alike and hence there is variation. Others had noticed that this is most certainly true where there are two parents, and not one as in plants which multiply by division such as the bacteria and some of the algæ.

But Mendel discovered that the ratio of the young that resemble either parent is as three to one. He noticed that where

some things come together, as black and white, the black is apt to hide the white, and hence he called the black dominant and the white recessive.

If we cross two hybrid black and white seeds or animals, what do we get? If we try the experiment often enough, we are sure to average a three to one ratio, that is, we get:

1 black, plus 2 mixed, plus 1 white.

If we use one characteristic such as color with two factors, such as white and black, we have four possibilities. If we use two characteristics such as color and size with two factors each, such as black and white with large and small, we have the dihybrid $(3+1)^2$ or sixteen possibilities. If we use three characteristics with two factors each we have the trihybrid $(3+1)^3$ or sixty-four possibilities, and if we use ten characteristics we have $(3+1)^{10}$ or 1,048,576 possibilities. These are sufficient to show that by using nothing but different combinations of the factors of the characteristics of the parents we are able to get a wonderfully varied plant and animal life. But we get them with the certainty of mathematics. "Whatsoever a man soweth that shall he also reap." *

These discoveries, made by men who were trying to work out and explain the Mendelian experiments, help to confirm the belief that species are fixed, have their birth, life and death as naturally as individuals. Plant breeders were unable to get results by following the theory of the slow variations of Darwin. Nilsson says of his work at Svalöf in Sweden: "Rigorous selection pursued for five years had produced only a relative uniformity; we could not show a single new and constant variety-character. And most of all, it was evident that our selected varieties, left to themselves for a year or two, unquestionably fell back to the condition of a mixture of the original varieties.

"Evidently we were unable to produce what the Swedish farmers wanted—better varieties, which would be constant. It was obvious that we must find a new method."

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* For showing the way the Mendelian factors segregate out, a system of checkerboard mappings has been devised. They simplify the work. If the reader is interested and wishes to learn more about the Mendelian ratios, he may consult Walter's "Genetics," Chapter VII, or Punnett's "Mendelism," or Davenport's "Principles of Breeding."

DeVries and the Mutation Theory.—Not only among the plant breeders was it necessary to get a new method, but among the scientists it was necessary to have a better explanation of what plants do in heredity. This led Hugo DeVries of Holland to announce his now famous *Mutation Theory.* By this we are taught that while it is true that most plants produce young that obey the Mendelian ratios, yet at irregular intervals and for reasons as yet unexplained some plants give off variations which do not obey the Mendelian laws—variations or sports, as Darwin called them, which are not to be explained by a combination of the factors of the parents. Now if these sports be prepotent—that is, if they have the power to hand on to their young and their young's young their peculiar variation—we have what DeVries calls a mutant. This means a sudden creation of a new species. This does not contradict Darwin's common descent of species, but it offers a better explanation of how new species arise.

Mutation and Plant Breeding.—The mutation theory gave a new impetus and a new method for plant breeding. With this theory a man is to deal with individual plants. He is to watch for new species or mutations and then, as in nature, there is to be a struggle among species to win his favor. It was the use of this new theory and the new method growing out of it that enabled Nilsson to become Europe's leading breeder of agricultural plants. Says Nilsson: "It is a fact well authenticated at Svalöf that mutations appear from time to time in our cultivated plants. Furthermore, we have found that spontaneous fecundation is much commoner than we had supposed."

Some Examples of Mutants.—Many illustrations could be given of what are believed to be mutants. The Concord grape came from a seedling of one of the wild grapes of New England, and from the Concord have come the Worden, Moor's Early, Pocklington, Rockland and others. Nectarines and apricots appear to have mutated from peaches and plums respectively. Other mutants are: The Hubbard squash, the Morgan horse (Fig. 29), DeVries' primroses, Swedish wheats (Extra Squarehead and Sol), oats (Klock II and Seger), barley (Chevalier II, Princess and Gull), peas (Concordia), and many American grains and fruits. But the reader needs to be cautioned that there is a group of scientists who do not believe in mutations

and they claim that these are hybrids. We lack analysis of their parents and histories of their ancestors so that we cannot prove for a certainty that these are mutations. However, the theory of mutations sets us to watch for the exceptional individuals. This theory also has led the breeders to use single plants and their progeny for their breeding experiments, and from this use of individuals we have some very valuable grains and fruits.

It is my belief that mutants are appearing in the farmers' fields and yards much oftener than we are aware of. Mutants in plants and domestic animals are of value only as we are able to recognize them and perpetuate them. Left to themselves, mutants soon mix with others and are lost to us forever. We need a generation of young people put into possession of the scientists' contribution to civilization so that we may carry on the work where our parents leave off.

"It is no stretch of the imagination," says Dean Davenport, "nor is it a chimerical dream to say that the students of our better schools, aided by their teachers, can, if they will, do more to further improve many of our cultivated plants than can the farmers themselves. They have the time and can acquire the skill—things which are difficult to secure to the man who is busy in active commercial life."

Possibilities of Plant Breeding.—It should be the aim of agriculture in the public schools to develop and inspire a practical plant breeder for every community. Wonderful things have been accomplished in plant breeding and more wonderful things seem just ahead of us. Napoleon had his men breed the sugar beet, and in a very few years they bred it from a watery garden vegetable with 3 per cent of sugar in it to the commercial beet containing 16 per cent of sugar. It is reported that the Experiment Station of South Dakota has a beet with 29 per cent of sugar. Porto Rico exports $25,000,000 worth of sugar from cane averaging 11 per cent of sucrose. The United States Experiment Station in Porto Rico, by crossing the native cane with a British West India cane, succeeded in getting a cane that averages 21 per cent of sucrose. Man has bred the apple from the little, puckery, gnarled crab to the almost numberless shapes, colors and luscious fruits found in our orchards. He has bred the seed from the grape and the orange, and created a new fruit, called the grape-fruit. Luther Burbank, whose biography every

country boy should read, has proven that we may breed the thorns from the blackberry, the rose and the cactus. Mendel, the Austrian monk, proved that we can find in plant breeding mathematical order of which most cultured people never dreamed. Professor Hayes, of Minnesota, raised the protein content of barley, and Professor Hopkins, of the University of Illinois, raised and lowered the chemical contents of corn almost at will. Professor Thomas Hunt, in that most valuable book for the farmer boy to read, "The Cereals in America," quotes Burbank as follows: "The vast possibilities of plant breeding can hardly be estimated. It would not be difficult for one man to breed a new rye, wheat, barley, oats or rice which would produce one grain more to each head, or a corn which would produce an

Courtesy Penna. State College.

FIG. 12.—Yields of corn from ear rows standing in the field in the order of the baskets.

extra kernel to each ear, another potato on each plant, or an apple, plum, orange or nut to each tree. What would be the result? In five staples only in the United States alone the inexhaustible forces of nature would produce annually without effort and without cost:

5,200,000 extra bushels of corn.
15,000,000 extra bushels of wheat.
20,000,000 extra bushels of oats.
1,500,000 extra bushels of barley.
21,000,000 extra bushels of potatoes.

"But such vast possibilities are not alone for one year, or for one time or race, but are beneficent legacies for every man, woman, or child who shall ever inhabit the earth. And who can estimate the elevating and refining influence and moral value of flowers, with all of their graceful forms and bewitching shades

and combinations for color and exquisitely varied perfumes? These silent influences are unconsciously felt even by those who do not appreciate them consciously."

Man may by care and cultivation make plants mature better seeds and fruits temporarily, but, by breeding, new plants may be created which will produce better always, in all places, and for all time to come.

Heredity is a force that works without expense. The farmer who lacks the skill or time and talent for plant breeding can afford to pay good prices for well-bred seeds. We need as a national ideal, instead of an old age of idleness as a retired farmer in town, an old age of helpfulness in breeding for his fellow-man " richer grains, better fruits, and fairer flowers."

Plants lend themselves more readily to breeding experiments than do animals; for greater numbers of individuals may be produced at small cost, we may propagate or multiply the superior ones more readily, and in many instances, when we once get a superior kind, we can increase the number by stem propagation with little, if any, tendency to variation. One who is a master of the Mendelian laws may propagate from seeds with little danger of undesirable variation.

Plant Breeding Psychological.—Then, too, the plant breeding is the psychologically correct place to begin agricultural study for it enables us to commence with something that the child can comprehend, and thus we may obey the law of apperception. Plant breeding enables the child to do something and to acquire something worth while, and thus it appeals to deep and lasting instincts of activity, acquisitiveness, imitation, and manipulation. It also enables us to bring into function the child's desire to get something more useful or more beautiful, and it appeals powerfully to curiosity and self-expression. Best of all, plant breeding enables us to give country people, both old and young, something to live for. Country boys and girls frequently lack ideals and purpose; plant breeding offers both. But we must not overlook the purely scientific side of plant breeding. The secrets of the universe are being drawn from nature to-day by the men who are in the plant-breeding work. Mendelism, the origin of sex, the possibilities of mutation, the cause of variation, and God's order for growing things are all to be found in the possibilities of plant breeding.

Name Improved Varieties.—Local pride may be inculcated by having pupils name superior varieties should any occur. We need more farmers who, like Washington, put their names or the name of the farm or variety on the sack or box. "Made in Germany" is a label that is adding money to the pockets of the German people. Why may not "Grown in Pennsylvania, Iowa, Wisconsin or Minnesota" be made to add to the value of the products of the people of states using such labels? This should be especially true of the products of farmers whose children have attended one of the redirected schools. Town people will readily give more for superior vegetables or fruit if they have a way of knowing that the product is really superior.

Set Standards High.—"God takes three months to make a pumpkin but He takes one hundred years to make an oak." So it is in life—good things come slowly. It is a great thing for a teacher to set the standard as high as she is able to get her people to respond to. The Ohio farmers set their standard for their registered corn to the requirement that an ear be of known parentage and rank not less than fourth for yield, protein or whatever characteristic is claimed for it, and rank so in competition with not less than twenty-five other ears in row tests. The boys in the Evergreen Corn Club in Iowa took their scrub corn to a state show. This was before they learned what good corn is. Their corn looked so scrubby in comparison with the better corn at Ames, that for the first show the boys did not open their boxes. But one of them bought good corn for seed. They went home and they studied corn and they planted and cultivated their best. In three years they had to hire a railroad car to carry home the prizes which they won, and for the next few years they won practically every time. If a boy or man could be induced to take five years to produce a new corn, oats, potato or what not, and if he were wise enough to judge what is wanted, and then if he had the executive ability to get results, he could ask a high price and yet get buyers for all that he could produce. Some people make the bad blunder of advertising their product before they have multiplied it often enough. One man began too early to advertise an improved alfalfa with the result that he could not fill a tenth of his orders. Some man who understood what business really is was able in a year or so to fill the orders that should have gone to the plant breeder.

Begin Plant Breeding with the Best.—It costs too much of human time and labor, and it costs too much of human life from the disheartening feelings at seed time, to allow land to be planted with inferior seed. The first step in improving our crops—whether vegetables, fruit, grains (as corn, rye, oats, wheat), grasses or potatoes and, for convenience, we may include cotton and tobacco—is to find what varieties are best for the district or section where the school is located. This does not mean that the teacher must necessarily confine her pupils to any one or two varieties. The work may easily become too burdensome if there are too many varieties on the school plots, but if the pupils take up the work as home-project undertakings, then

Courtesy Penna. State College

Fig. 13.—Timothy plots. Here new varieties are compared with ordinary commercial timothy.

each may, after careful study as to which is best, select the one he and his parents decide is best. It will be time and energy wasted to start with inferior varieties; none but the best should be selected. Our Boys' and Girls' Club motto is, "To make the better best and the best better."

The State Experiment Stations carry on many experiments to determine the relative value (Fig. 13) of the different varieties of grains and vegetables. Hence, if the teacher wishes to know which are the best varieties for her locality, she may write to the experiment station for the information, or she may talk with some of the leading farmers of her district. At this point she should remind the pupils of DeCondolle's law that plants

should not be moved more than one degree north or south at any given time unless we wish to change their character. Webber has found that if climbing or twining beans or viny peas are transplanted from a southern to a northern climate, or from a lower to a higher altitude, they tend to produce dwarf types which show little tendency to twine. Corn from Kansas, if planted in Iowa, seems to grow larger stalks and smaller ears. Farmers of Pennsylvania take advantage of these well-known phenomena and buy their seed for silo corn from the south, near Richmond, Va.

County Farms as Experiment Stations.—In many places the county farm is used to determine the relative yielding tendencies of different crops. In Iowa, for example, Professor Holden had his helpers go over the county and get little paper sacks of seed corn from different farmers' planter boxes. This corn from each farmer was planted in a row on the county farm. The same was done with oats and wheat. When the crops were ready, the farmers came to the farm for a fall picnic, and there were able to see the relative yielding power of their seeds compared with that of others. One man found that his corn yielded thirty bushels to the acre, planted side by side with that of a neighbor, whose crop yielded at the rate of seventy bushels to the acre. This work alone has enabled teachers to enrich their districts a number of times over the cost of running the schools. Page County, Iowa, where Miss Jessie Field introduced this work, sells over a million dollars of seed corn each year. Wright County, Iowa, where Mr. O. H. Benson while county superintendent introduced similar work and where the Evergreen Corn Club boys live, also receives many thousands of dollars for pure bred seed corn and other grains. There will be few with forethought enough to appreciate the value of the work at first, but, as Shakespeare says, "There be one or two whose good opinion outweighs the hundred." Then, too, teachers of intellect and foresight must get their approval for what they undertake largely from within their own consciousness.

BREEDING THE CEREALS

How to Breed the Cereals.—With seed from a good variety, the pupils should be encouraged to start a breeding patch. This may best be done as a home project, though there is much to be learned and enthusiasm to be gained from starting a breeding

plot for the school. If the work is started in the fall, the pupils should visit the fields or stacks of the district and gather some of the best heads to be found. The grain from each head is to be planted in a row by itself. It was this method of dealing with individual plants that made Nilsson's work at Svalöf bring such rich results. The pupils should make an effort to be competent judges of what is needed, and for this the score-card work given in the chapter under "Grain and Stock Judging" is needed. They need the help of the farm bureau man, the experiment station men and the brightest farmers of the district. "Hitch your wagon to a star," says Emerson. Get a clear idea of an ideal plant for the purpose intended; then watch for variations toward your ideal. When threshing time comes, some interesting correlation work in history can be done. The crops being in small amounts will not justify threshing with modern machinery, and hence the pupils may be led to thresh their breeding crops as people did in the past. The first way is to thresh it in the hand. Then man invented the flail, the method of whipping it over the edge of a board stood on edge, etc. Let the child mind review the progress of the invention of improved threshing machinery and methods at the time he has threshing to do and he will remember his history and find history interesting.

For breeding corn or wheat, a patch in the school garden that is well fenced may be selected. But a patch, say one square rod, in a field next to the school yard is better in a number of ways. The square rod should be selected, say, two or three rods from the edge so as to insure a plot not enriched by dust from the road and a plot where the grain will not be injured by stray animals that may break in and devastate the crop near the fence. Let us use the diagram given in Fig. 14. Let *F* be the field, *BP* our breeding plot, and *MP* our multiplying plot. The first year, when the men do the seeding, they may throw the seeder out of gear as they come to our breeding plot (*BP*) which should be a square rod or so in area. The grain on our breeding plot is to be sown by hand in individual rows, each row or part of a row from one head. Good, well-marked stakes should be set at the ends of each row or part of a row planted from each head. At harvest time the grain is gathered in bundles, each bundle being from one row. The best heads may be selected for the breeding plot another year. The balance of the bundle

may be used for school exhibits, but used carefully and then threshed for seed the following spring. The seed from the select heads is to go into the breeding plot the second year and the seed from the bundles is to go into the multiplying plot. The third year, the seed from the heads go again into the breeding plot, that from the bundles into the multiplying plot, and that from the multiplying plot into a part of the field. We prefer to have our seed from the multiplying plot planted side by side with the regular field crop to enable us to compare relative yielding tendencies.

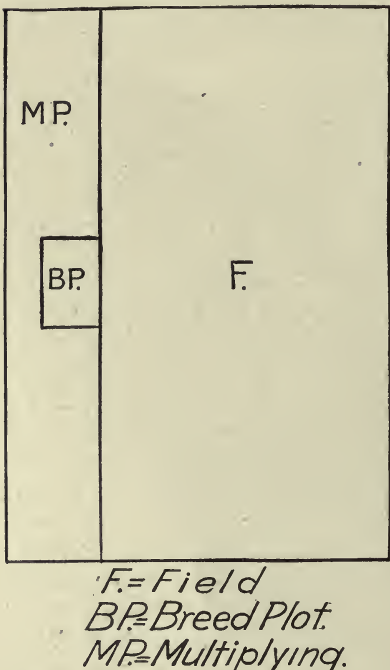


FIG. 14.—Grain-breeding plots.

Pupils who have cameras should be asked to take pictures of every step taken and especially of the bundle displays at school exhibits and county fairs. Some system of keeping accurate records of yields, parentage and descriptions should be adopted. The most approved system for the district should be in harmony with the records kept by the local breeders' associations or the State Experiment Station, hence the teacher should aim to learn how their records are kept.

Again I wish to caution teachers not to undertake too much. The work is accumulative. It is better to help to improve the most important crop, as the wheat or oats. It is very much better to do a little well than to do much poorly. After all, the improvement of the grain is not so important as the education of the child. It is the getting of the child interested in improving the grain, it is in making the child conscious of what must be done, it is in awakening a neighborhood to the possibilities of plant breeding, that the great benefit is found.

FIG. 15.—Agriculture is the study of real objects. West Chester Normal pupils helping a farmer to select his best ten ears for the Corn Show. Notice national champion ear in glass jar on table. Pupils need to see the best for comparison.

BREEDING CORN

Why We Study Corn.—There are a number of reasons why corn makes a good subject for classes in nature study, botany or agriculture. The corn plant is a typical monocotyl (Fig. 15). It is planted before school closes in the spring and is not harvested until after school begins again in the fall. It is grown from Porto Rico and Mexico to Canada. There is some home activity connected with the corn plant for every month of the year. (See correlation chart in Chapter XV.) The corn plant is large and the parts are easily seen without the help of a microscope. Pupils may learn to be good judges of seed corn (Fig. 16). Seed has to be gathered and preserved carefully. Seed must be gathered at a critical time; if left too long it may be frozen and if gathered too soon it may mould. Farmers live an isolated, busy, individual life and hence need the help of the school or Grange to make them conscious of the fact that seed-corn week has come and there is danger in delay. Corn is relatively a new plant and, while it obeys the laws of heredity, owing to its newness and its peculiar characteristic called xenia, it varies so widely and so frequently that each kernel offers interesting possibilities. Cross pollination shows on the outside of the kernels (xenia), and that brings surprises. Each ear produces from 800 to 1000 kernels and if well preserved will yield from three to five dollars worth of corn the following year. The commercial value of corn is greater than that of any other single crop. The business world in America, at least, is greatly dependent upon the corn crop.

FIG. 16.—A corn club boy. Look, old man, the young man is after you. He makes a real study of corn.

Corn has many beautiful poems and legends such as "Mondamin,' Riley's "The Frost am on the Pumpkin, and the Fodder's in the Shock," Whittier's "Corn Song," and others. Corn pleases the senses, challenges the intellect, and is associated with the beautiful in painting, architecture, prose and poetry.

How to Breed Corn.—A year's work on corn is outlined in the chart in Chapter XV, but here we are interested in how to breed corn. We should start with seed of the best type (see Fig. 17) and variety. The corn score card is given in Chapter IV. From now on seed can probably be obtained from one of the boys who has been doing work in the corn clubs. He has a right

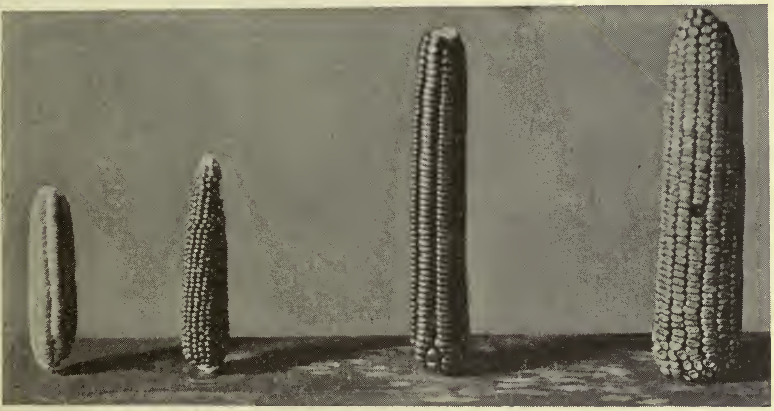


Fig. 17.—Four types of corn, sweet, pop, flint, and dent.

to use the United States label (Fig. 18), but if he abuses the right, he may have hanging over him the penalty for violating both the United States copyright law and the post-office laws. Having obtained the best ears to be found, we keep them until about March and then test them for germination power.

How to Test Corn.—The Iowa Experiment Station, after having tried all of the different testers, decided that there is nothing better for the average man than the old seed-corn box. This consists of a box preferably 15×25 inches. The bottom is covered with about three inches of sawdust that is thoroughly wet and has recently been boiled. The damp sawdust is covered with a piece of cloth ruled into squares $2 \times 2\frac{1}{2}$ inches. The

head of the box should be lettered (see Fig. 19) at the top and numbered along the side. Each ear is to have a label corresponding with the label on the box, A/1, A/2, A/3; B/1, B/2, B/3, etc. This label may be pinned on to the butt of the ear with a sixpenny nail. Six kernels from each ear are to be placed in each square—two from opposite sides near the butt, two from near the centre, and two from near the tip. All of the kernels should point the same way. The kernels from each part of the ear should be so placed that we may tell from what part of the ear they came. When kernels from all of the ears are on the

FIG. 18.—National corn club label.

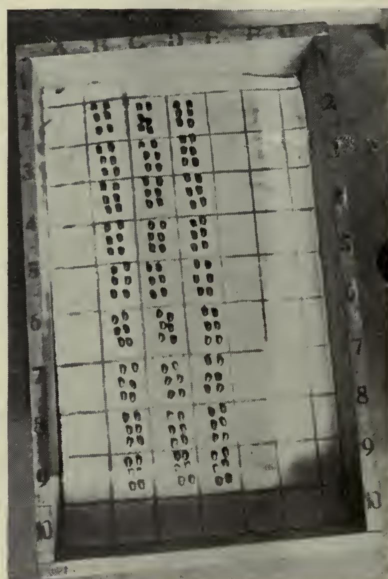


FIG. 19.—A seed testing box. Notice the way it is lettered and numbered, and the way kernels are placed.

checks or when all of the checks are filled, we cover the kernels with a light cloth and then wet them thoroughly. Then we cover all with an old piece of sack or carpet and leave the box in a warm place for four or five days.

This germination box makes interesting school work. The relative germinating power, the appearance of root and stem, the size and location of root hairs, the power of a little plant to feed on the contents of the seed, the turning of the leaves to green as they begin to function for photosynthesis, the appear-

ance of one leaf after another in what is called a monocotyledonous plant—all are to be found in a seed-corn box.

Grading the Planter.—Unless one is to plant by hand, he should go over the planter before planting time and see to it that the plates are able to plant kernels of the size which he may have and plant them at the rate he wants. It may be necessary to file some of the holes in the planter plates in order to make them the right rize for the kernels.

Shelling the Corn.—If one wishes to breed his corn for high yield, he should shell one-half of each ear and place the kernels of each ear in a little sack numbered the same as his ear is numbered (Fig. 21). The corn from sack one is planted in

Fig. 20.—The 1912 champion ear for Northeastern United States. Same as No. 1, Fig. 21.

row one, from sack two in row two, and so on. The corn should be planted in ordinary soil, prepared in the ordinary way, given the ordinary fertilizer and cultivated in the ordinary way. We wish to have the corn do well under average conditions or we wish to discard it. This first year's work is really a test year to see which ears will yield heavily. Some yield at the rate of seventy, some thirty, and some one hundred bushels per acre. Our new corn will probably be pollinated with the pollen from the low yielders. But we have half of each ear left, and for the second year we discard the low yielders and plant heavy yielders only. Each row should be husked and the corn kept until weighed separately for each row. The best ears from each row

may be kept for seed for a test plot the next year, one-half being kept as was done with the ears the first year.

Teach a Boy to Win in the Acre Contest.—In many localities there is much interest in the acre contests. There are many places in both the north and the south where free outings with expenses paid to Washington or to State College are given for the winner in the boys' contests. That being true, it is well for the teacher to have boys who are interested in the acre corn contest, begin a booklet with a view to making it their guide while they are in the contest. This will provide interesting work for every month of the school year. While there may be

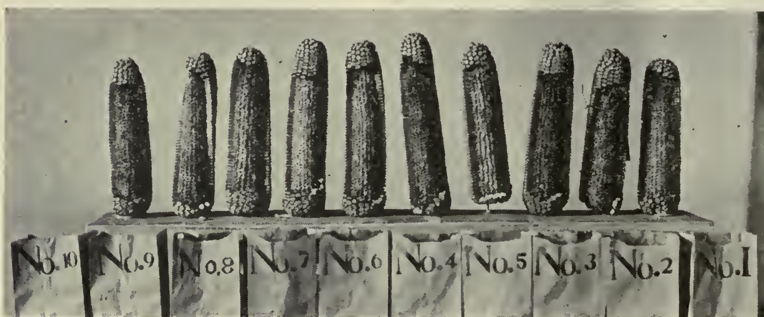


FIG. 21.—National champion winners, shelled for the ear-row breeding. One half of each ear is planted the first season, the other half, of the high yielders, is planted the second season.

introductory chapters on the origin, use, history, etc., of corn, the main topics on which the boy must work and the ten items where mistakes must not occur are the following:

1. Selection and preparation of soil.
2. Selection of the best seed.
3. Testing of seed and planter.
4. Methods of planting.
5. Fertilizing and preparation of seed-bed.
6. Cultivation.
7. Insect enemies.
8. Weed enemies and plant diseases.
9. Saving seed.
10. Harvesting.

The government bulletins, the agricultural papers, the lectures at the short courses and farmers' institutes, the text-books on agriculture, and the larger books such as Bowman and Crossley's "Corn" and articles in Bailey's "Cyclopedia of

Agriculture," must be read and carefully digested in order to make sure that their directions apply to the locality where the boy lives. These contests will be close and the winner will be the one who leaves no stone unturned. To become fully conscious of just why each thing is done when growing an acre of corn, is a valuable part of any boy's education. Not until they are in the acre contest can you make some boys or their fathers believe that some ears tend to yield at the rate of eighty to ninety bushels to the acre, while other ears that look much like them cannot be made to yield more than thirty to forty bushels. When he is in the acre contest, the weather and the weather reports take on new meaning to a boy. When he is in the contest, the weeds and insects of a neighborhood have a bearing on his life that he could not have been made conscious of before he entered. Birds suddenly become his friends. Old men who have been successful farmers become intensely interesting to the boy, and without his knowing it life takes on new meaning and he is learning one of the most necessary lessons in a democracy, namely, for the laboring man to find pleasure in the content of his work.

Courtesy Penna. State College.

FIG. 22.—Potato balls and leaf. The new varieties of potato are secured by planting the seeds in these little fruits.

POTATO BREEDING

In some parts of the country the potato crop is more important than the corn crop, in which case the emphasis should be placed on the breeding of potatoes. It is frequently claimed that potatoes "run out," and by the theory of species creation and extinction, this is true. Whether potatoes "run out" or not, the secrets of larger yields are in seed selection for blight-resistant, high yielding tubers, and in the creation of new varieties by planting the seed from the "potato apple" (Fig. 22). The potato blossom is not attractive to insects, hence the

berry does not often form. But occasionally the berry does mature and, if the seed is saved as we save tomato seed and planted as we do the tomato seed, we may get an improved potato. Luther Burbank's experience leads us to believe that about one in ten thousand may be an improvement over what we now have.

Tuber-unit Selection.—Farmers are frequently planting large, good-sized and good-shaped potatoes. These should be cut in quarters and the four pieces planted in four consecutive hills. The next four hills should be planted from another single tuber

Fig. 23.—Tuber unit planting. Two rows, four hills from each tuber. The four hills below the hat have their tops entirely killed by the early blight, the others doing well.

and so on. There is interesting work throughout the season watching the potato patch to see which tubers give tops that are strongly resistant to the blights. Some succumb very easily and some stand with blight and destruction all around them (Fig. 23). Of course the power to resist blight does not insure a high yielder. We must wait until digging time and then dig the potatoes with a fork and keep those from each hill separately. Then we may compare results. The boys in the national clubs who have done this work may use the national label, which is somewhat like the label used by the corn breeders (Fig. 18).

If the work is begun in the fall instead of the spring, we start with hill selection instead of with tuber-unit planting. For hill selection we go over the field in late August or early September and mark hills that have stout, blight-resistant tops. This is done by carrying an armful of little stakes and setting one at each approved hill. Then we wait until digging time and fork out the potatoes, placing the tubers from each hill together. We compare yields, and if we are national club growers we gather seed from those that have not less than six good-sized, good-shaped, high-scoring tubers to the hill. (For the potato score card, see Chapter IV.) The potatoes from each hill should be saved in little sacks; these sacks may be placed in a barrel and the barrel kept with the other seed potatoes. We wish to have the seed endure ordinary care and treatment. The next spring the potatoes from each hill-unit are to be planted in rows by themselves. If we select six potatoes from each sack, cut each into four pieces and plant one piece, we have row-units of twenty-four hills each. These are convenient units. Since we are dealing with stem selection, we may have our breeding patch for potatoes in rows along a side of the regular field. We wish to give the tops a hard test for blights; the more they overcome the better the seed we get.*

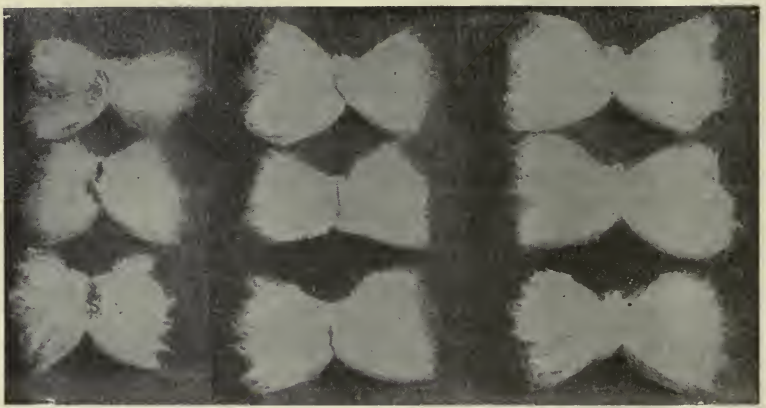
In addition to breeding for or selecting better seed, some of the boys will want to enter the potato-growing contest. In many counties, the banks, private individuals, the colleges and other institutions offer prizes well worth striving for. The West Chester, Pa., State Normal School gives a trip to Washington with the senior class to the club winners; others give the winner a free trip to State College for the Short Course. In order to win as a potato grower, the boy needs to know:

1. How to get the best seed.
2. How to select the best acre.
3. How to prepare and fertilize his soil.
4. How to plant.
5. How to spray and cultivate.
6. How to advertise, pack and sell.
7. How to keep clean, neat, accurate booklets of his work.

These may be learned from reading the government bulletins

* For lesson plan on potato breeding, see Chapter XV.

and the special circulars issued by Mr. O. H. Benson for the boys and girls in the clubs. Farmers should not be urged to try too many varieties; one good early and one good late potato are enough. The same is true for the boys and the schools. Again the work is accumulative and there is danger of teachers undertaking to do too much. "A little well done" should be our motto. We are doing the work largely for the thinking that it may make the children do. It does not take much plant breeding to induce a great deal of thinking. We are trying to help "make the better best and the best better." Some one says, "The best seed obtainable is none too good."



Courtesy Country Life in America.

Fig. 24.—Three years of cotton breeding.

The teacher must not miss the deeper and broader meaning of the plant breeding. As Coulter says: "We do not want our boys to become merely efficient farmers who have learned to do certain things that make more dollars. We want them to be men who realize the larger applications of the laws and principles they are following, men who see and discriminate, who grasp situations, who think for themselves, and who have an abiding interest and enthusiasm for their profession, looking upon their fields, orchards and meadows somewhat as laboratories in which to work out experiments to the end that they may do their work more profitably and enjoyably."

QUESTIONS AND STUDIES

1. Most of our text-books begin with the subject of soils. Is that or plant breeding the better subject with which to begin? What are the advantages of each?
2. Explain how the study of agriculture may lead to a desire for the sciences taught in a first-class high school and college.
3. Are the possibilities of plant breeding overdrawn for your locality?
4. Why and how do we bud? Graft? Mound layer? Propagate by cuttings?
5. Give five laws of plant breeding.
6. How do we breed root crops? Corn? Potatoes?
7. How do we propagate apples? Peaches? Grapes?
8. Summarize the advantages of plant breeding over animal breeding.
9. Who are the leading plant breeders of your district and what does each breed? Does he show at the county fair and state shows? If so, what?
10. Who are the leading plant breeders? The leading American?
11. Summarize what has been achieved in plant breeding to date.

References.—DeVries' "Plant Breeding;" Webber's "Plant Breeding" (in preparation); Articles in Bailey's "Cyclopedia of Agriculture"; Walter's "Genetics"; *The Journal of Heredity,* published at Washington; Experiment Station Reports and Bulletins; Carnegie Institution Reports; High School Texts in Agriculture; Farmers' Bulletins, U. S. Department of Agriculture; Sears's Productive Orcharding.

Pets are the child's natural introduction to animal life.—Hodge.

A large element in the life of a child is the companionship of a dog, a cat, or some other pet.—Holtz.

Thou shall not destroy in all of my holy mountain; for the earth shall be full of the knowledge of the Lord, as the waters cover the sea. . . . The wolf also shall dwell with the lamb, and the leopard shall lie down with the kid; and the calf and the young lion and the fatling together; and a little child shall lead them.—Isaiah.

The subject of pets is of widespread interest and includes a large variety of animals. The most common and important of these in America are dogs, cats, rabbits, guinea-pigs, mice, rats, squirrels, pigeons, bantams, and cage-birds. The localities where they seem to be most numerous are about the manufacturing towns of New England and the Middle Atlantic States, thinning out as the west is approached. Statistics indicate that there are more pets in the State of Pennsylvania than in any other State.—Ellard, in Bailey's "Cyclopedia of Agriculture."

CHAPTER III

PETS AND HOME PROJECTS

Educate the Motor-minded Child.—Most people think of education as learning from books; they have in mind the receptive type of child. Others, who have in mind the motor-minded child, think of education as adjustment, which they define as including the acquisition of power to adjust environment to the needs of self as well as the acquisition of power to make the best of whatever is inevitable. The ideally educated person would be both perfectly adjusted and able to enjoy getting and having knowledge from books. While we cannot reach the ideal, we can enable every one to acquire a reasonably large body of information to serve as the basis for reasoning, and to acquire a much larger degree of adjustment than is now possessed by the typical man or woman.

The history of education shows us that our present school course of study was not made for the motor minded. It was handed down from the monasteries to the colleges and from the colleges to the academies and high schools, and from these to the common schools. The course of study was not made for active men and women who have to make their own living but by and for the meditative minds who find their ideal life in the monasteries and libraries. Just a little critical inquiry into conditions in the public schools shows that the motor-minded boys and girls soon become discouraged in a bookish school where they are in unequal competition with their receptive or bookish classmates. Soon the motor minded drop out because they find little of interest in the schools for them, and yet these motor-minded ones are valuable citizens and far outnumber the bookish people for whom the school and college system is now run.

The mind of the motor-minded child does not work easily in books because he deals with the concrete, while books contain mostly the abstract. The motor-minded child is usually a logical thinker but he needs what he is learning brought into relation with something in his past in order to make his mind catch fire

and go to work. His power of attention is strong so he fails to become conscious of near and vitally related subjects. For a half century we have had no adequate discussion of these pupils, who are entering our schools by the thousands. For a time they struggle in the unequal competition with the bookish who have come and will go up regularly through the grades; but soon the motor-minded boy discovers that he is losing ground in the contest; then he finds interests outside of the school and in a short time quits the school for ever. Poor fellow, he does not know that he belongs in the same class with Linnæus, Darwin and Miss Martineau; with Napoleon Bonaparte, William A. Seward and Patrick Henry; with Newton, Dalton, Samuel Johnson and Dean Swift; with Wordsworth, Sheridan, Humboldt, George Eliot, Walter Scott, Lyell, Cuvier, Byron, Beecher, Lowell, Goldsmith, Priestley, Goethe, Emerson, Gladstone, Sumner, Chase and a score of others who were poor in book work at school. God pity the farm boy who makes up his mind that he is an ignoramus because his teacher, his parents and his school fail to understand the wonderful equipment with which he entered school.

The Farm and the Motor Minded.—The farm produces better observers than does the town, it produces better reasoners, it gives discipline in meditation, it calls frequently for quick judgment and action, but it does not enable boys to become so apt in books. The farm boy works too hard and uses book learning too seldom to become very proficient in writing, reading and spelling without extra effort. Is it just to this boy from the farm to place him in a school where the teacher measures everything by books and where the other pupils of like age are much further advanced in books? This active country boy goes to school and is told to sit still for a long, long time, as it seems to him. He is told to study from books which contain ideas entirely foreign to things in his experience or to things in which he is interested. He is given no clue as to how the printed page may help him or how to connect what is on the page with what he has done or expects to do outside of school. Is it any wonder that nine out of every ten children in the United States do not go to school after they are fifteen years of age? We are not good shepherds if we spend our time, as educators have in the past, counting the one that is saved while the nine are lost.

Books May Weaken Executive Ability.—Book-learning is not an unmixed blessing. Books frequently lead to an overdevelopment of consciousness coupled with an underdevelopment of executive ability. Too much knowledge, or an overdevelopment of consciousness, may lead one to see so much on both sides that he loses the tendency to act with promptness and force on either side. Cicero is the classic example of one who was overly conscious and therefore hesitated to take part with either side. Julius Cæsar, on the other hand, is the classic example of a man broadly conscious, and who from his very breadth and depth of consciousness was able to act with irresistible force and promptness. Mr. Roosevelt is another man who is wonderful in his breadth and depth of consciousness, who is interested in the widest variety of activities, and yet who never hesitates to act with force and promptness for the right, as he sees the right.

President Roosevelt saw the dangerous defect in our public schools and called attention to it in the following words: "Our school system is gravely defective in so far as it puts a premium upon mere literary training and tends, therefore, to train the boy away from the farm and workshop. Nothing is more needed than the best type of an industrial school, the school for mechanical industries in the cities and for teaching agriculture in the country. No growth of cities, no growth of wealth, can make up for any loss in either the number or the character of the farming population. We of the United States should realize this above almost all other people. We began our existence as a nation of farmers, and in every crisis of the past a peculiar dependence has had to be placed upon the farming population, and this dependence has hitherto been justified."

One reason why country boys so often surpass town boys is that the country offers abundant material for calling out and developing the executive side of the boys. The handling of a team and other domestic animals, the handling of farm machinery, the outwitting of game, the catching of fish, all call into activity executive tendencies of a higher order. The history of the child and of the race shows that there always has been, and there is yet, "a crown for him that overcometh." But life in the country is apt to be lacking in the social and emotional elements. This may lead to pranks, rowdyism and

contests of brute strength, but, notwithstanding these coarse and vulgar attractions, life in the country is still apt to be lonesome and to become monotonous. The emotional and social craving must be satisfied partly by the love for and contact with domestic animals and pets.

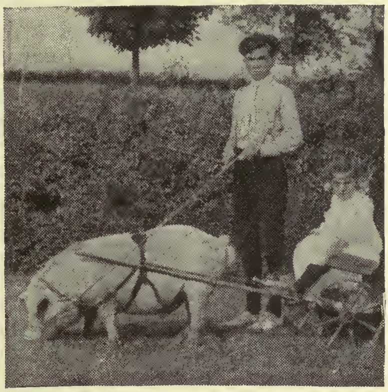
Courtesy Country Life in America.

FIG. 25.—A pet is a child's natural introduction to the animal world.

Again, the parallel between the child and the race shows us that the connection between the lower animals and man is much closer among children and primitive people than among those more advanced. Among some of the primitive tribes the domestic animals are nursed by the women. We are told by the anthropologists that in the Philippine Islands even the little pigs

are nursed by the women from their own breasts. The love for, and power over, many of the domestic animals, which is possessed by women and children, as yet defies analysis for hidden causes. The story of Alexander the Great when a mere stripling, riding the fractious horse, Bucephalus, is paralleled on nearly every farm where boys and colts are being reared and trained.

Pets for Introductory Zoology.—The heart is sickened when one thinks of our present methods of introducing the child to nature study and zoology. Left to himself, the child would never begin by killing, destroying, dissecting, tearing to pieces or trying to classify. Not more animal anatomy but more animal activity is what we need. Professor Hodge in his epoch-making book, "Nature Study and Life," says:



Courtesy Successful Farming.

Fig. 26.—Plays of the young are preparatory for activities of life.

"Pets are the child's natural introduction to animal life. By their means the knowledge gained of the animal as a whole, its habits, life, individual character, intelligence, affection for its master, its health and well-being, is infinitely more living and real than imparted by any other methods of instruction. By its association with the child's spontaneous activities in caring for his pet, this knowledge becomes a part of his life and will thus enter into the formation of his character to exert its civilizing influence as long as he lives. Of how little value compared with this is learning of names, schemes of classification of anatomical structures.

"In the development of the child's moral and emotional life, this relation of his living pet is of even greater importance. Nothing is better fitted to develop patience and conscientious carefulness than the daily attention to its needs. Unselfishness is fostered by this care and by the generous sharing of his things with his humble friend.

"Play is coming to be recognized more and more as an im-

portant factor in life and in education. Nothing as fully brings into healthful activity every function and power; so that Froebel truly says, 'A man is a whole man only when he plays.' Plays of the young are preparatory to the activities of adult life (Fig. 26), and pet plays prepare, as nothing else can, for the most important of all functions, the caring for the young. The care of the pet involves the same reasoning, the same thinking and feeling and willing and doing, as the care of the child. Finally, the love of nature is a thing of slow growth. It begins when the love of a child flows out toward some one specific thing; it gathers force when something else is loved, and so on until he loves so many things and has come to look so deeply into nature's heart that he feels the love of all nature. This is a result worth years of patient education."

Agriculture for Fall Months.—The winter covering of plants and animals may well furnish some interesting material for booklets, compositions and opening exercises; but pets make an equally interesting subject, and a booklet, or a series of discussions during the early winter months of the school year, may lead some careless one to develop forethought which will lead him to provide his pet a better place for winter quarters. These discussions on pets may incidentally lead to the dissemination of much valuable information. The subject of pets offers an excellent field for the awakening of latent sympathies and for the stimulation of the tendency to thoughtfulness and care for, and kindness toward, our dumb but valuable friends. Love grows slowly and we rarely find a man who loves his domestic animals who does not love his family; and we seldom find a man brutal to dumb animals who is not also brutal toward wife and children.

Every child should some time in his life own one or more pets. Their educational value is immeasurable. I could not lead my little boy to understand why mamma and papa punish their children until he got a little puppy, and I told him to punish the puppy just enough to make him remember not to do his naughty tricks. At first, like a savage, the boy was disposed to be cruel, but gradually he learned what punishment was for and gradually he awakened to a consciousness of why children are punished. Then the lessons in observation, in self-control; the development in tact and skill in harnessing and breaking

the dog, calf or colt, the caring for the pet and the learning that added goods mean added responsibility—all these are lessons as valuable as anything taught from books. More than that, these things may be made to lead to an intense desire to read some good book on the care, feeding or handling of the dog, sheep, colt, or whatever the particular pet may be.

Many a boy of the motor type who now finds nothing he considers interesting or valuable in school will have a new birth when the teacher gives him lessons on his particular pet. He may now be learning to read very slowly, but the desire to learn more about his pet may be utilized as a stimulus to read more by giving practice in supplementary work in reading from government bulletins and books on the subject of his pet, or some aspect of the subject, such as diseases, housing, feeding, etc. The same lessons may furnish the very topic on which he will be pleased to write compositions that tell his experiences with his pet. The boy, the school and the home are now in many instances pulling in three different directions, and the teacher has but to call to mind the well-known law in physics to learn the result; but let them all three pull together and the result will be something entirely different. If, instead of counting the saved, we for a time count the lost from our schools, we will be persuaded that some changes are necessary.

One Way to Introduce Agriculture.—If you do not know how to introduce elementary agriculture, or if you find your nature study uninteresting to the pupils, begin to ask them what they do for their pets and you will find you have started a never-ending story. Since gentlemen must wait for ladies, we will tell the boys that we are soon to have a lesson on their pets, but we will hear about kitty now. Remember that pleasing oral expression is a valuable accomplishment, so we will allow the children to tell all they can about the pleasures they derive from, and what they do for, kitty. Teachers may profit by the philosophy of the old Quaker who heard a man swearing. Going up to him, the old Quaker patted him on the shoulder as he remarked: "Thou are right, thou art right. The sooner that thou gets that out of thee, the better."

Care of the Cat.—After the teacher has drawn from the pupils what they know about the care of the cat, it would be well, if there is in the library a good book on the cat or one with a

chapter on the cat, to have some bright pupil who has his lessons learned, and who is likely to be in mischief while waiting for the others to get their lessons, read up on this subject so as to be able to report at the next discussion. If there is nothing in the library to be read, the teacher may add something. In Miss Champion's article on the cat, in Bailey's "Cyclopedia of Agriculture," we find the following which may be of interest: "In raising cats, meat should be the staple diet. This may be mixed with green vegetables, but farinaceous and starchy foods, such as rice, oatmeal and potatoes, should be strictly avoided; water should be given to the cat to drink, and no milk. The latter is peculiarly indigestible to cats. Cats should be kept excessively clean, both as to freedom of their coats from all vermin and in regard to their quarters. They are naturally very clean in their habits.

"Cats are very susceptible to dampness. While they will flourish in a dry, clear, cold climate and require no heat in such a climate, dampness will bring on many ills, such as pneumonia, ophthalmia and distemper. The principal causes of mortality in kittens are indigestion and distemper."

Other valuable bits of information may be given, as that the coats of both cats and dogs catch fleas which may be readily killed by a thorough soap-suds bath given to the cat or dog.

Care of the Dog.—Says Hodge: "Among the many who keep dogs but few know how to take proper care of them. Most people over-feed, thus allowing the dog to grow fat, lazy and stupid. For an adult dog one meal a day, given in the evening, is generally better than two or three. It should consist of dog biscuit or the coarse table scraps, bread crusts, brown bread, oatmeal, bones with not too much meat, and vegetables. In severe weather or with much exercise in the open air, a dog needs to be fed oftener and to have more food. The best indication as to whether the feeding is proper is the condition of the animal. He should be neither lean nor fat, but sleek. One should be able to take up a handful of soft, loose skin anywhere on the dog's body. A gnawing-bone is the dog's tooth-brush, and he should be kept well supplied at all times, both for business and amusement. Too much meat and lack of cleanliness are apt to give rise to offensive odors, the "doggy" smell of animals not properly cared for. Fleas are the great burden of a dog's life. To

kill every flea on a dog it is necessary to lather him completely with some mild, clean soap, Castile or Ivory; let it stay on for two or three minutes, then rinse in clean water or let the dog take a swim. A dog is thus the best possible flea trap. He will pick up every flea in the house or neighborhood, and then they may be easily killed. If every one did this, which is no less than he should wish to do for the health, cleanliness and comfort of his pets, a neighborhood might soon be rid of these pests. For other matters as to the dog's health and care, their owners should be referred to standard authorities."

Fig. 27.—Dog kennel. A good home project.

There are a number of good dog books which some of the boys will like to read. But before I leave the subject, I must quote from that excellent set, which every well-to-do farmer who wishes to become well informed should have in his library. Every dog should have a kennel which he may have as his home, and where in case of sickness he may be isolated and cared for properly. The kennel should be located where it will receive plenty of sunlight, where there is good drainage, and where it is easily accessible. In "The Pet Book," by Mrs. Anna B. Comstock, she tells us: "The best kennel is one that can be cleaned and aired when not in use. It may be a wooden box or a barrel, turned upside down, placed on a platform raised

a little above the earth; or it may be an especially built house (Fig. 27), but, of whatever form, it needs to be roomy, protected from the cold winter winds and shaded from the summer's sun.

"For the dog's bed, a layer of clean straw is best, and this should be changed every week. Sawdust, carpets, and mattings are not desirable as bedding, since they harbor fleas. When the kennel is scrubbed, disinfectants should be used, and it should be perfectly dry before straw for the bed is put in place. The walls of the kennel should be whitewashed, or painted with creolin, to keep them sweet and clean. There should be sand in front of the kennel, and, if the dog is chained, a chain from six to nine feet long should be used, and there should be always plenty of fresh, clean water within reach."

FIG. 28.—Oxen used on farms near Philadelphia. Ox power is, for many farm operations, cheap power.

Many Kinds of Pets.—Other animals such as guinea-pigs, rabbits, canaries, pigeons, parrots, chickens, etc., make excellent pets and give children valuable experiences. Lack of space forbids a detailed description, but their presence may make it necessary for the teacher to include them among her discussions. There remain two which connect us very closely with successful farming, and the information gained about each will be used all through life.

Every Boy Should Own and Break a Calf.—That boy who missed breaking a calf missed a chance to develop part of his executive possibilities. The calf is more docile than the colt and hence makes a better animal for the small boy to handle. Nor is that all. There are a number of farmers near where I am living in Pennsylvania who use oxen (Fig. 28) for part of their farm operations. A study made of these farms and farmers

by us in connection with the United States Bureau of Farm Management, shows that these are farmers who are making their farms pay. We see no reason to doubt that ox power is a cheap and, for many operations, a very satisfactory power. Hence the boy when breaking the calf may, as do children so frequently when playing, be preparing for a later life work. He may be acquiring the very reactions, the very understanding of movements that will later enable him to lay hold of a very cheap and economical farm power. But we are most interested in making a man of the boy, and breaking and handling a calf with kindness and skill do much to develop the best that there is in the boy.

An old buggy axle with a pair of cultivator wheels, or any pair of low wheels, makes a good start for a cart. The buggy axle should have about a foot cut out of the centre and then the two ends welded together. Then a pair of thills may be bolted on, an old buggy box adjusted to the rig, and we have a very convenient calf cart. Primitive man used things that were large and strong. We make a mistake by urging our children to play with the light, delicate, useless playthings. Almost any boy can rig up a calf harness out of old straps, especially if given an old breast collar or breeching. Rope lines will do. Many handy things can be done with the calf and cart. Little chores, short market trips, vegetables from the garden, apples in small quantities, grass taken from the lawn, and a hundred and one things may be done as play with the calf and its cart. And all the time the boy and his companions are storing up beautiful memories, developing originality, executive ability and kindness.

The school must not ignore this experience. The children will love to tell of it, write about it and read similar experiences of others. If rightly directed, the experience with the calf leads to the desire to know how to care for, breed, and handle cattle.

The Boy and the Colt; the Man and the Horse.—No other animal means more in farm life than does the horse. The horse was perhaps domesticated before the dawn of history. The remains of the horse furnish us the most complete extant record of the development of one of the higher animals. His ancestors roamed the American continent and then, for some reason, their descendants seem to have disappeared until the horse came over with the white man to again roam the southwestern

part of the United States. Literature for ages past is found to contain references to man and his love for his horse (Fig. 29). Hodge says: "To learn to control and ride a spirited horse is an education in itself."

Training the Colt.—A very practical book for the farmer is Gay's "Productive Horse Husbandry." In Chapter XII, under "Care of the Colt or Foal," we are told: "One of the light web halters is preferable to the heavy strap halter, and care should be

Courtesy Country Life in America.

FIG. 29.—A Morgan horse. A good illustration of American carriage horse.

taken not to pull heavily on the noseband at any time. Many deformed face lines have been caused by this means. It is not necessary to drag a colt by the halter in order to suggest to him that his business is to follow. As a matter of fact, the reverse effect is usual, and the harder a colt is pulled, the harder he pulls back. If, on the contrary, he is coaxed along some accustomed route, as to the water trough and back, he will soon catch on and follow promptly whenever the halter is taken in hand.

"The first time the colt is tied up by the head, see to it that

the halter will hold him in case he pulls. If he does and fails in his first attempts, a string will probably serve as well as a chain to keep him in place thereafter, while if he succeeds in freeing himself at the first few attempts he will never cease trying to repeat what he has once accomplished."

If a colt has formed the naughty habit of pulling, he may be broken of it by tying a loop or small noose in one end of a small rope about ten to twelve feet long. The rope is thrown around the body, the end passing through the small ring or loop, and the rope placed so that it will draw tight just in front of the hind legs or just back of the fore legs. Then the long end of the rope is passed between the fore legs and up through the lower or chin halter-strap. The end of the rope is kept in the hands with the halter-rope. When the colt begins to pull, the rope is tightened around the flanks or body, and this breaks the colt very quickly of his tendency and desire to pull back. As Gay points out, the colt has fewer ideas and is much more ready to follow a superior intellect when young, but once let bad habits form, and there may be trouble ahead in breaking him of them.

This does not mean that a colt is best put to work when young. His education and his work are not the same thing. Many colts are injured by being worked too young, but few are injured by being broken too young.

"The profit and pleasure to be derived," says Gay, "from the use of the horse of any class are so dependent upon his being readily subservient to his master's will that the earlier this spirit is created the better horse he will be. A common custom in the Middle West is to take the unbroken two- or three-year-old, put him between two or three other horses to a gang plow, and thus 'break' him. He pulls when the others pull, makes the turns when they do, and finally becomes of about as much service at that work as the other horses in the team, but he is not broken. Take him by himself and he will not stand, back, lead, rein, or allow a foot to be picked up without as much resistance as, or more resistance than, was offered before the breaking process began."

The important thing for the boy and the teacher to understand at this point is the fact that physical force is a very poor means for breaking and handling a colt or a horse. The horse is too powerful an animal for man to handle by physical force. Right habits, lack of fear, kindness, and a clear understanding

of the means being used are what we are aiming to have the colt acquire. He must know what the halter and, later, the bridle and the words of command are for; he must form the habit of doing just one thing as a reaction to each. The superior intellect is trying to control the inferior intellect. No chances should be taken with the colt, but the superior intellect should see that at every turn the colt does exactly the right thing.

The colt should early be educated to the bit and the harness. If a colt has been well broken to the halter, a boy does quite as well as a man to break the colt, providing the boy knows what to do. A light bridle with a medium-sized and comfortable bit may be put on the colt while he is a "yearling." Then a light back-band or surcingle may be put around just back of the fore legs. The colt may be checked up, but there is nothing to be gained by checking him so high that he must hold his head in an uncomfortable position and hence work to get the bridle off, the check broken, or the head released. So soon as he has wandered around the yard for a half day or two, with the bridle, back-band, and crupper in place all of the time,—that is, so soon as the colt has learned that there is no use trying to get these off or out of place, —he is ready for the lines. For these we need two loops—one at either side—such as we use on the single harness for the hills. These should be securely fastened both down and up so that they will stay in place along the side. The lines should be run through these, and the colt driven so that he cannot turn and get one line over his back.

While being driven with the lines, the colt should learn to stop at the command "Whoa!" and he should learn to start at the command "Get up!" He may be taught to back, to stand still, and, if he is to be a work horse, to begin to obey the commands "Gee!" and "Haw!" Gradually more of the harness may be put on and the colt accustomed to it. The breast collar may be put on, later a full leather or humane collar may be on while the colt is being driven by the lines. A boy readily learns what parts of the harness to use, but a lady teacher may do much to impress the boy with the fact that the parts must be so put on as to stay in place, and the colt must not be frightened by their getting out of place and the colt and the boy having a mix-up.

A boy who is interested in physics and horses should read Gay's chapter on "Relation between Horse and Master." And

both boys and girls who are interested in good driving should read the chapter on Equitation. Says Gay, Chapter XVI, on Equitation: "There is a sentimental opposition to a recital of the horse's mental limitations which must be overcome, and these limitations appreciated, if the most satisfactory service is to be had from him. For instance, it has been alleged that the horse is both a fool and a coward, and while these uncomplimentary terms may arouse the ire of the horse lovers, and apparently justly so, it is the actual possession of these two traits, perhaps more moderately called credulity and dependence, which makes it possible to use the horse at all with safety and satisfaction. Our whole system of breaking, schooling, and driving is fundamentally deceptive. We aim to give the horse an exalted notion of those of his powers which are useful to us, and at the same time create the idea that certain others, which might prove detrimental to our purpose, are hardly worthy of the horse's consideration."

Good driving is a fine art of which any boy or girl may be proud. There must be the most delicate adjustment and response between the hand of the driver and the mouth of the horse. A master is able to drive with the left, and thus free the right hand to take up the whip or to help the left hand in emergencies. Most of the time the near rein should be held over the forefinger and the off rein between the middle and ring fingers. If the knuckles are turned forward and nearly perpendicular and the forearm is held horizontally and at nearly a right angle to the lines, the position is easy and enables one to guide the horse along an unobstructed road. If the horse is to turn, the other hand may help.

When the colt is first hitched to a vehicle, he is to go, and there is to be no kicking about it. This makes it best to hitch the colt to a strong vehicle, and, if single, to use the kicking straps until habits are well formed. If the colt is hitched double, he should be hitched with a reliable mate that is responsive to commands. And, again, the wagon is to be reasonably heavy and in every way strong and reliable. The vehicle should be so placed that the start is easily made and there is a clear field for a reasonable distance. There are to be no accidents the first time the colt is driven.

A balky horse is generally made by a balky driver. If the

colt is well driven the first few times, if he is not hitched to a load heavier than he can pull, and if no accidents happen, we are reasonably sure that we are to have a true horse. A responsive, true, reliable horse is an achievement of which a boy may be justly proud. The breaking of a colt is the training of the most complex animal next to man, and to train the colt skilfully is to get splendid preparation for handling either men or horses.

From Pets to Home Projects.—From pets a child passes naturally to home projects, and these make excellent connecting links between home and school. Home projects as developed in Massachusetts and as advocated by the United States Bureau of Education are undertakings of economic importance which are supervised by some one from the school. The theory of how to carry on the project is learned as part of the regular school work, and the application of the theory is made at home for economic gain. The care of one or more cows to see what can be done to lower the cost of feed or milk; the care of a team of horses to learn the number of hours worked, the cost of feed, the most advantageous labor schedule; the care of a pen of pigs; the care and feeding of a steer to learn the cost of producing beef, especially baby beef; the management of part of the poultry flock, the trap-nesting of hens (see Lesson Plan, Chapter XV), the housing, feeding, running of the incubator or brooder—any of these make home projects well worth while.

These home projects offer us a chance to illustrate what we are trying to do with agriculture in the school. With nature study, we aim to get pupils to observe and to love nature. Agriculture is utilitarian. With agriculture we aim to get pupils to know and to do things that are better than the things now being done. Contrary to what most town people think and what the town papers emphasize, we are not aiming primarily at getting an increased production. We are not aiming primarily to get more food for town people to eat; that is a town problem and it is for town people to solve. But teachers of agriculture do aim to make farming more profitable to the farmers. With this in mind, the teacher should be alert to learn what is worth while, what can be done that will pay her people more net profit than they are now getting. This makes the teacher alert to find what is new and yet to be sure that it will pay.

Poultry for Home Projects.—No subject surpasses poultry for home projects. Poultry is found at every farm home, the girls are frequently as interested in it as are the boys, and the women of the district are generally more interested than are the men. The value of poultry products in America equals the combined value of the gold, silver, coal and iron mines. The value of the poultry products is equal to the value of the hay crop, the wheat crop, or the cotton crop, the corn crop alone surpassing poultry products in value.

"With the gradual refining of agriculture," says Bailey, "and the application of business methods to it, we have begun to realize that it is possible to greatly extend the business of all kinds of fowls. . . . We have learned that any real satisfaction in the rearing of poultry must come as a result of as careful attention as that given to any other kind of live-stock. The question of breeding, feeding, diseases, and general management are complex and are much in need of scientific investigation. . . . The reputation of the poultry business as a separate enterprise has, no doubt, suffered from the exploitation of it by many persons who have gone into it thinking it an easy and rapid road to fortune and a means of recouping broken health."

Robinson, in his splendid book on "Principles and Practices of Poultry Culture," says: "Indiscriminate reading of poultry literature is a hindrance oftener than a help. Only carefully selected standard books and papers should be used. The fictions of poultry culture are mostly plausible and generally more alluring than facts. . . . A person with a little skill in carpentry may design and build a house in every way as good as any experienced poultryman . . . provided that the principles are understood and correctly applied. But in feeding, a working knowledge of principles is rarely if ever acquired without practice. . . . The student who learns or has good cause to suppose that the poultry plant on which he is working is maintained from other sources than the annual income from poultry will, as a rule, find it to his advantage to leave it; for he is not likely to learn there to do a profitable day's work in a day, and he is likely to acquire habits and an attitude toward his work which permanently impair his efficiency."

Housing.—Before one can tell how to house poultry, he must know under what conditions the poultry is to be kept.

For a small flock in a city yard, a small house such as that given in Fig. 30 is best. This house is seven by fourteen feet on the ground. It has a floor and is set up two feet above ground, which gives a run-way equal in size to the size of the house. The front from floor to roof is five feet. It was designed by a young lady who read what she could find, digested what she read and then designed her poultry house. It fits her yard, it is not unsightly and it shelters twenty hens very nicely. The house cost less than forty dollars. This house has the attributes of a good poultry house. It is dry, easily kept clean, well lighted, and well ventilated. The cost was less than two dollars per hen. The colony houses (Fig. 31) used in the North American con-

FIG. 30.—A home project. A section of a normal school class studying the home project. Notice no glass, plenty of light, good ventilation, and easily kept clean and dry.

test are large enough for ten hens, are economical, make good home projects and are very convenient to use for half-grown chicks or for hens and little chicks, though a coop does equally well for the hen and her chicks.

Discussions of how to care for eggs and how to breed hens for more eggs are given in the lesson-plans in Chapter XV. There is much interesting work in biology to be learned from handling poultry. We know that a hen is born with all of the embryo eggs she can ever have. We know that she will probably be eight to ten years laying her eggs but man may by proper care, housing and feeding, get all of the eggs that she will lay at a profit in from one to three years after she begins to lay. In

fact, unless eggs are wanted to set, it rarely pays to keep a hen more than one year after she begins to lay. Then, too, we know that hens differ in the number of eggs that we can get them to lay in a year. One hen laid 303 eggs in 365 days; the average hen lays 80 eggs in the same time. At the North American contest the 500 hens averaged over 170 eggs. One more egg to a hen in the United States would give us some

FIG. 31.—A good colony house. A good home project for boys in either town or country. Notice no glass, only light cloth for door.

$4,000,000 worth of eggs over what we are now getting. That would help wonderfully to give us the most efficient schools in the world.

The subject of feeding hens is treated in Chapter V.

Incubation.—Artificial incubation has come to stay. The Egyptians and the Chinese have used the fireless mud incubator for thousands of years. There is a chance for bright young people to do the incubating for the farmers of a district.

In some colleges and normal schools the pupils run the incubators as part of their regular work in agriculture. The larger incubators (Fig. 32), heated by water, which in turn is heated by coal, give better satisfaction. There are a number of rules for running the incubator which are teachable. Among them are:

1. Select part of the hens that show constitution, vigor and vitality.

Fig. 32.—A commercial incubator. Run and heated by a hard coal stove, which warms the water in the pipes.

2. Trap-nest these the first year. Sell the eggs. Do not allow male bird to mate with these the first year.

3. After a reasonable rest with good feeding, mate the best layers from these with males whose ancestors were known to be egg strains. From these matings get eggs for setting.

4. Set incubator in a well-ventilated room where the temperature does not vary rapidly or far.

5. Overhaul incubator carefully to be sure that it is in good order and to be sure that you understand all parts.

6. Start the incubator some days before you are to put in eggs, to be sure that you understand how to run it. Be sure that the lamp burns freely and that the regulator regulates.

7. Disinfect the incubator carefully before each setting is put in.

8. Be sure that the incubator is set level as this insures an even distribution of heat in the incubator.

9. Use high-grade oil that will not smoke or char the wick.

10. Keep the lamp burner clean. If necessary boil it.

11. Be sure that the wick is long enough to reach the bottom of the lamp. Put in a fresh wick for each hatch. Many hatches are spoiled by having the lamp go out or the temperature go too high because of a faulty wick.

12. Fill the lamp in the afternoon. This insures a supply of oil and a freshly trimmed wick for the night.

13. Put the eggs in during the forenoon so that the eggs may become warmed through and the incubator regulated before night.

14. Do not handle or even touch the eggs with oily hands.

15. Test eggs on the sixth or seventh day, throwing out infertile eggs.

16. Keep the machine dark during hatching time. Do not open it unless absolutely necessary.

17. Follow the manufacturer's directions. He probably knows best how his machine should be run.

18. Leave the chicks in the nursery for twenty-four to forty hours after hatching. They do not need feed.

19. Don't spend your valuable time helping weak chicks. If they can't get out of their shells they probably are not worth helping.

20. Have the brooder ready and transfer the chicks to it without chilling them. Start with the same temperature for the brooder that you had in the incubator and lower gradually, say five degrees per week, beginning after the second or third day.

Laying Contests.—The farmer has never warmed up to the poultry shows as some school teachers and the fanciers seem to think that he should. There is a very good reason for this.

The poultry business, so far as shows have been concerned, has been run by men who were breeding for feathers and forms, while the farmer is interested in hens for more eggs. But the fancy breeders have done a valuable work. They have taught us that we may get pretty much what we want if we have a clear aim and breed for it long enough. But there has been growing discontent among the poultrymen with the shows. The *American Standard,* a book issued by the American Poultry Association, has never been of great interest to the farmer. It tells how to get hens for feathers and the farmer wants to

FIG. 33.—The Storrs, Connecticut, contest house. Notice no glass, plenty of air and light; the house is dry and inexpensive.

know how to get hens for more eggs. This insistent demand for the utility hen led some of the agricultural colleges to start the egg-laying contests. There have been contests running in Oregon, in Missouri, at Storrs, Connecticut (Fig. 33), and at Delaware College at Newark, Delaware. The one at Newark was started as the North American contest, and it did as much as any perhaps to show what can be done. Each man paid twenty dollars to enter his hens. He entered five hens for one year, but he could send seven so as to have two to take the places of others should they become sick or die. All of the hens were kept under

absolutely uniform conditions. The houses were alike (Fig. 34). There were five hens in each little house. The houses were cleaned each day. All of the hens were fed with mechanical

Fig. 34.—North American egg-laying contest where 500 hens were kept under uniform conditions and made an average of over 170 eggs each the same year. Every hen was trap-nested for each egg.

or automatic feeders (Fig. 35) so that each hen got feed just when she wanted it. Each feeder was filled, as explained in the chapter on feeds and feeding, once a week. The hens in each house were given a dish of fresh water twice each day.

Fig. 35.—Automatic feeder.

The third year the 500 hens averaged 170 eggs each. One pen of five Wyandottes laid 1180. A Columbian Rock laid 286 eggs in the year. 131 of the 500 hens laid an average of over 200 eggs each. This is not an exploitation of the exceptional. These are records that can be reproduced on any good poultry farm. Tom Barron of England was owner of the winners in each contest and he had bred his hens for eggs. There were no male birds with any of the 500 hens. Each little house was provided with five Stoneburn trap-nests, and each hen was trap-nested for each egg. (For lesson plan on use of the trap-nest, see Chapter XV; and for Poultry Judging, see Chapter IV.)

A Sow and Pigs for a Home Project.—There are many club boys in the United States who are caring for a sow and her pigs as a home project. This pig club work is just now more popular in the southern States, but boys in Iowa and other northern States are interested. The swine project offers the teacher of agriculture another chance to illustrate what we are trying to do with agriculture in the school. Primarily, we are trying to educate boys by getting them to think more, read more, write more and do more in a better way. Secondly, we are trying to demonstrate to the people of our districts some of the things which the scientist has worked out for them. The farmer is a busy man, he has so many things to look after, there is always something that needs to be done, hence he hesitates about trying anything new. Yet new things must be tried or we make

From "Productive Swine Husbandry" (Day).

Fig. 36.—An individual hog house. If made by the boy and if the sow and pigs kept in it are cared for by him, it makes a good home project.

no progress. Then, too, what the teacher advocates may not pay, but if she gets a boy to introduce the thing as a home project and if he makes a success of his home project, which means if he makes it pay, and pay better than what the farmer is now doing, then the teacher has a thankful convert in the father, she has a farmer more interested in the school and much more willing that his boy shall continue in that school.

The home project for the sow and her pigs should consist of selecting the best sow for a mother. Then the boy should build his individual hog house (Fig. 36); he should fence a piece of land, with room enough to keep his swine clean, to furnish pasture, and yet not waste ground. He should keep a set of books in which he debits the swine for time, fence, rent of land, feed, and other expenses. When he has his pigs partly grown, he is ready to learn of hog cholera (Fig. 115) and how to prevent it. Books that were of no interest to him before be-

come intensely interesting now. He is ready to read such a book as Day's "Productive Swine Husbandry" with interest. If the school library lacks such books, the home projects are very sure to create a demand for a library with books of vital interest to the people of the district.

Corn and Canning Projects.—In connection with home projects I must call attention to the "acre of corn" projects. An acre of corn is large enough to challenge the manhood of a boy, it

Fig. 37.—Home project boys. Champion corn club boys for Northern United States. One from each Congressional district. One grew 157 bushels of corn at a cost of 13 cents per bushel; another grew 146 bushels on his acre, at a cost of 9 cents per bushel.

The National badge shown in front has a book as a background. The book stands for knowledge, the four-leaved clover stands for fertility of the soil and good luck. There is a corn kernel on the center of the clover leaf to designate the corn club, and then there are four h's—one in each leaflet. The h's stand for the health, hand, head and heart in human service. The boys are demonstrators of what can be done.

is hard enough, there is profit enough in it, and it enables one to learn what there is to be learned about growing corn. A description of the club work is given in Chapter XIV, but here is the place to call attention to the fact that there are some 100,000 boys each year in the acre of corn contest. The winners have been given a free trip to Washington (Fig. 37). There they have been received by the President and given diplomas for achieving, or, as they would say, "demonstrating," what can be done in agriculture.

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Half of the garden truck in America rots on the ground. Half of the people do not get all of the canned goods they could use to advantage. Many country girls go to the city in order to make spending money. The average farm woman thinks that she has done a reasonably good summer's work if she has canned 100 quarts for her family. And yet in the canning clubs, hundreds of girls are learning (Fig. 38) each season how to can 300 quarts in a day. We are just learning that the best canned vegetables are the ones that are canned as soon as brought

Courtesy O. H. Benson.

FIG. 38.—Operating a canning outfit of the steam pressure type in the home kitchen.

from the garden. The girls, too, are demonstrators of what may be done to make woman's work efficient. This club work offers us a chance to start continuation schools in America. Nothing is more needed. We need teachers paid, as are some of the Massachusetts teachers to supervise the home projects, for twelve months in a year. If teachers of domestic science and agriculture have vacations, they should have them in the winter time. One Massachusetts school contracts with the teacher of agriculture for twelve months with the provision in the contract that one month shall be spent in a first-class agricultural college,

preferably at the short course, and the other month in the winter may be spent as the teacher chooses. This enables the teacher to supervise the home projects during the months that the pupils are not in the regular school, and by having some reading done during the summer months the work may be made lighter when other school work is heavy. But the pupil with a home project is to work alone as much and as soon as he is able. The teacher of the home project is not to be a crutch but rather an adviser who organizes the young people and enables them to gather enthusiasm from each other.

QUESTIONS AND STUDIES

1. Are the motor-minded children having a fair chance in our schools?
2. Should the pet cat and pet dog be outgrown as girls outgrow the doll?
3. Are farmers making money raising colts in your neighborhood? If so, how do they handle them?
4. What is the popular breed of horses for your locality? Why?
5. How are work horses fed and cared for in your neighborhood?
6. How are dairy cows fed and housed? Is there a better way?
7. How are hogs handled in your locality? Is that the best way?
8. Describe a good home project.
9. Describe a good poultry house.
10. Outline the steps to be taken for a club boy to win with the breeding and handling of two dozen hens for winter eggs.

References.—Bulletin No. 8 for 1914, U. S. Bureau of Education; Massachusetts Home-Project Plan of Vocational Agriculture; Massachusetts Bureau of Education Reports; Texts on Animal Husbandry; Day's Productive Horse Husbandry, Parts I and IV; Government Bulletins; State College Bulletins and Circulars; Bailey's Cyclopedia of Agriculture; Lewis's Productive Poultry Husbandry.

Fig. 39.—A dog should have a kennel which he may consider as his home.

This competitive element enlists the whole child, brings into action every scrap of power to think, reason, investigate, experiment, to will and to do, of which a child is capable.—Hodge.

With such contests as these there will be something going on in the country community to think about and to talk about. Many of the tasks of the farm and the farm home do not require much thought or mental direction, and the mind needs fresh materials to be worked over at such times.—Curtis in "Play and Recreation."

Judging is selection. . . . It should not be understood to mean the placing of awards in the show ring, although that is a most important function of the judge, imposing upon him the responsibility of establishing ideals and standards which are to lead or mislead the rank and file of breeders. The successful buyer or breeder must be a competent judge, whether he has ever placed a ribbon in a show ring or not.—Gay in "Productive Horse Husbandry."

CHAPTER IV

STOCK AND GRAIN JUDGING

Score Cards a Racial Inheritance.—From millions of toilers coming down the ages, we have inherited certain knowledge and certain types of farm plants and animals that are peculiarly adapted to specific purposes. Our schools have no right to let the farm boy become a man unconscious of these types and of the purpose for which each is best adapted. The sons and daughters of the better farmers will learn much of these from their parents, and it is not right that we teachers neglect the children of the poorer families and hence force them to start doubly handicapped from inheriting neither capital nor knowledge. In the European countries where agriculture is taught in the schools, young and old go to the fairs with score cards in hand to see, and to see critically. The *new agriculture* demands that we in America create something of a desire to get pleasure from critically judging stock and grains.

It is a well-known fact that at our " Short Courses " we find men who, when boys, could hardly be driven to school and who when they did go, crawled to school like snails, but when these same fellows became men of forty and sixty years of age they have been seen running from building to building so as not to miss a word of the next recitation. I asked the great corn man, Professor P. G. Holden, why this was so, and he said because of the method used at the " Short Course " and because of the motive given to everything.

The Use of the Score Cards.—The score cards, copies of which are given in this chapter, are not infallible guides, yet they represent the epitomized attributes which many careful observers through long periods of time have found to be characteristic of the best animals and plants. There are middle-aged men who by a kind of intuition can judge stock and grain fairly well; but in order to enable the boy to begin where his father leaves off—that is, to be a good judge early in life—the score card and some discipline in its use are indispensable. If the young learn

to become good judges early, they must be made clearly conscious of the desirable attributes of the different farm products. It is often surprising what an apparently inferior mind can and does accomplish with practice under careful guidance. A boy whose mind is turned in the direction of stock or grain judging may, though not considered very bright, become an expert judge by the time he goes to college or begins farming for himself.

Score cards are changing, though they are not changing very rapidly. The teacher should aim to get copies of the latest approved score cards. Those given in this chapter are all in use in one or more of our leading agricultural colleges.

Types and Breeds.—In his article on the use of the score card, in Bailey's "Cyclopedia of Agriculture," Professor F. B. Mumford says: "The long-continued selecting of domestic animals by man has resulted in the development of certain distinct types, each of which is peculiarly adapted to supply some human need. Thus among horses are the draft, coach, roadster, and saddle types; among cattle, beef, dual-purpose, and dairy types; among sheep, wool and mutton types; among hogs, the bacon and fat types. There are many modifications of the types here mentioned, but these are distinctive and sufficiently general to include the important breeds of domestic animals."

The term *breed* is used to apply to one class of a certain type. Breed has reference more especially to color and form while type has special reference to purpose. An animal whose ancestors are known to be sufficiently pure may be registered and the owner may get a copy of the register, which copy he calls the *pedigree*. The dairyman, finding that too much attention was being given to the fancy points, created a standard for production. By this, if a cow gives enough milk for a sufficient time, she may be admitted to advanced registry. The poultrymen are just now trying to make either two classes of poultry, utility and show, or else create a new registry which will be for hens that lay a given number of eggs in a year. The terms *type, breed, registered* and *pure blood* should not be confused with the term *Thoroughbred*. A Thoroughbred is an English racehorse. Any animal whose parents are registered is a full blood; one with one or more parents not eligible to registration is a grade. An animal from parents both of which are pure blooded but not of the same breed, is a cross-bred.

Stock and Grain Judging for Adolescents.—The score card work is peculiarly fitted for the adolescent. Young children may become interested in grain and stock judging, but the adolescent child is hunting for excitement and notoriety. Up to adolescence the child is fairly content to be under the control of others and to do as told, but at adolescence he desires to be treated as a companion and not as a subordinate. Up to adolescence he idolizes mother and father, he looks upon them as the embodiment of all wisdom, but at adolescence there comes a change and it is important that a child then gets a good ideal. At adolescence the child seems to have his renascence and wants to get in epitome all of his racial inheritance. In short, he wants to know all there is to be known. There is then the same danger in agriculture as in religion, that when the child becomes conscious of the higher ideals he will turn with too much aversion from the ideals or possessions of father or mother. The teacher should aim to inculcate a spirit of open-mindedness and tolerance. Evolution is better than revolution. There must be some good in the things of father and mother, so if we wish to attain better things we should do so slowly. There is danger of the discord between child and parent spreading to the school, and at times it is necessary for a sharp and spirited contest to rid some farm or neighborhood of its inferior stock or grain. The teacher must use tact and good judgment, but she may be doing real missionary work even if it does cost pain and trouble.

The Score Card for Contests.—The restlessness of the adolescent child and his inherent longing to do something that attracts public attention may be utilized by the school in getting him to use the score card in order to enter the contests at the fairs, short courses and institutes. Here would seem to be a place for all. While athletics and debating offer opportunities for the few, stock and grain judging offer a place for all. One may be fond of driving horses; if so, let him master the score card on driving horses. Another is fond of corn, let him master the corn score card; another the score card on fat cattle or hogs; another the dairy cow, poultry, sheep, or small grain. Where the school is large instead of using individuals the teacher should group the best ones into teams or clubs and have teams judge cattle, hogs, horses, etc. If the girls prefer, there should be judging of cooking and products for cooking, such as vegetables

and fruits. These contests may be made to inculcate a lasting interest in the old farm. If a boy wishes to win with his corn, let him set about producing a winning corn. This makes necessary the learning of how to improve the soil and the cultivation, and not only the learning how but the seeing that it is done. Many farms, where children now long to move to town, would be populated with children who could not be driven off if only in their earlier years they had been started toward producing some winning grain or animals.

Standardization a Characteristic of Our Age.—The new agriculture copies from the industrial age in which we now live its most noted characteristic, which is the tendency to standardize everything. This is found in the wide adoption of uniform weights and measures, in making the different parts of machines so that they are interchangeable, in the making of bolts, auger bits, nails, twine, rope, and hundreds of other things so that now a man may buy from numbers or names. Even the length of a working day, the time of credit, the size of clothing that we wear and the grading of the food that we eat have felt this modern tendency. But, strange to say, the arithmetics, while apparently standardized beyond the possibility of change, fail to give the boy or girl things which belong to them as part of their racial heritage. There is much in the arithmetics which a child will in all probability never need, and there is much which he will need that is not in the arithmetics as yet. Very few teachers can tell what a farmer means by a three-eighths bolt, an inch and a quarter wagon tire, a standard ear of corn, No. 1 wheat, oats, rye, or barley.

There may be danger of bringing on arrested development by being too accurate or drilling too long on abstract things; but nevertheless the child should be taught that this is becoming increasingly an age of accuracy. Neither arrested development nor fatigue is apt to follow being accurate if the child is allowed to do actual measuring or comparing of concrete things. And while we advocate the constant use of ruler and tape measure as the child enters upon the study of denominate numbers, it is especially important that he has the tape measure always at hand for measuring the parts of plants and animals. This constant use of the tape measure explains why children taking up agriculture learn more arithmetic than those not taking agriculture.

The Discoveries of Darwin and DeVries.—The most epoch-making discovery of the last century, according to ten of our leading college and university presidents, was the discovery of evolution as recorded in Darwin's "Origin of Species." Darwin came to his discovery by meditating on the Malthusian law as he watched the European farmers slowly and carefully, but certainly, improve their stock and grain by selecting the best adapted to their purposes. It was but a short leap in thought from this to the idea that God is the great Farmer and is gradually making things better by natural selection which insures the survival of the fittest. As explained in the chapter on Plant Breeding (Chapter II), this theory of Darwin has been supplemented by the mutation theory of Hugo DeVries.

Applications of the Darwin and DeVries Theories.—Both of these theories have immense practical application for the farmer who undoubtedly must get his best stock and grain from a painfully slow selection of the fittest. If, however, a man has in mind the ideal type and if a wide variation toward that ideal does appear, then, like DeVries, that man may be present when God creates a new variation if not a new species. When one of these mutants appears, the farmer has the chance of a lifetime to secure an improved kind of plant or animal. Think for a moment of what the world would have lost had the owner of the famous horse, Justin Morgan, failed to recognize something of his value! Dean Davenport says, "The Morgan horse is a breed established by a single animal, and yet a hundred years after the death of Justin Morgan, when the per cent of his blood is necessarily slight, the Morgan characteristics still stand out clearly, constituting a type almost as distinct as that of any existing breed" (Fig. 29). For a time Americans forgot the Morgan horse and made popular the ugly looking racer, but to-day the national government is spending many thousands of dollars to reëstablish and make popular the American carriage horse which is to be a horse with the Morgan characteristics.

How to Begin with the Score Cards.—Since we learn most easily by imitation, the teacher without experience in stock judging would do well to attend the stock judging at some short course or institute (Fig. 40). After that she may study the score card carefully to make sure that she understands each point and what part of the animal is mentioned, also

the reason for the score card calling for the given size or shape. A number of the text-books on agriculture give pictures of the different animals with the different parts named or numbered. It is well to score one of the pictures and to have the class begin on pictures taken from farm journals. But scoring a picture is a very different thing from scoring a farm animal, therefore the work should not stop with the scoring of a picture.

The class must lay aside frivolity and sentiment. Scoring calls for the closest attention and the sharpest observation and discrimination. We must look upon the animal as a machine for doing work, secreting milk, putting on flesh or wool, or producing whatever is required.

FIG. 40.—Pupils judging a horse.

Score Highest What the Market Demands.—Sociologically the city problem is that of congestion while the country problem is that of isolation. His over-development of individualism frequently works to the farmer's hurt. We must aim to make the coming generation of farmers, while happy in producing what they like, yet wanting at all times what the market demands. Our county fairs, grain and poultry shows often work a detriment by placing emphasis on the non-essentials, as the feathers instead of the egg-laying characteristics of the hen; or the beauty instead of the productiveness or market qualities of the grain. The teacher must use discrimination, and, while passing lightly on the "fine points," mark off heavily for the deficiencies in things which the market demands.

We need good courses in commercial geography adapted to

local conditions. This commercial geography should emphasize the study of how the farmer may adapt his productions to fit the demands of the different markets. Denmark teaches her young people how to make butter that sells in the English market at from five to eight cents more than ours does. Denmark also teaches her farmers to grow and pack pork from hogs whose meat sells for more than ours. Why not teach American farm children to produce what the market demands?

HORSE JUDGING

Judging is Selection.—Judging does not necessarily mean the placing of prize animals or the awarding of ribbons in a show ring. Judging means the selection of what one wants for his purpose. It is used when one has to buy animals. There are different kinds of judges, and this fact often causes confusion to the farm boy. There are buyers who have a standard in mind, they will buy nothing under their standard, and with that in mind they are able to buy an animal per minute. But these are very apt to be better buyers if they learned when younger to judge one animal at a time and to judge critically. The one who wishes to buy a pair of horses has a very different problem to solve in determining which is best for his purpose than has the man who is buying a carload of horses to sell. Judging is the balancing of one attribute against another and then selecting for the margin of utilities. It takes experience to know just which to pick of a number of animals offered. But it does not take an extended experience to learn whether an animal is worth considering for the purpose intended. One who has had little experience and who goes over an animal point by point is frequently able to make a better selection than is an older judge who is unable to score an animal.

Examining the Horse.—"The most logical system," says Gay is in his excellent chapter on Horse Judging in "Productive Horse Husbandry," Chapter XI, "of examination begins with the view of the horse from in front, noting the temperament and disposition as indicated by the expression of the countenance, all features of the head, the width and depth of the chest, the station, the direction of the forelegs and feet. Then passing to the side, near side usually, consider the stature and scale, length or compactness, station, depth (especially in the flank),

carriage and shape of head and neck, the shortness and levelness of the top line, the length and straightness of the under line, height and shape of the withers, the slope of the shoulders, direction and conformation of the forelegs and feet, the back, rib, loin, flank, coupling, croup, tail, stifle, thigh, direction and conformation of the hind legs and feet. From the rear the symmetry, levelness, width, rotundity of hips, fulness of thighs and quarters, direction and conformation of hind legs and feet." Then we pass to the opposite side and view to confirm the observations on the other side.

Classification of Horses.—Horses are classified under two general types as light and heavy. The light are again divided into carriage, coach, riding, racing, pony, etc. These are divided into horses that have been bred for uniformity of shape and color and hence are breeds. As explained elsewhere, the word *Thoroughbred* is used for the English race or riding horse. Other horses may be registered or have a pedigree. Among the breeds of light horses are the English Hackney, the German and the French Coach, the Morgan (Fig. 29), Hambletonian, etc. If there is a family particularly interested in any one of these breeds, some of the children should read up on the origin and advantages claimed for that breed. The pupils should score at least one light horse in order to learn the differences between the light and the heavy or draft types of horses.

LIGHT HORSE SCORE CARD

[From "Productive Horse Husbandry."—GAY]

	Count
General Appearance.—12.	
1. Height	
2. Weight	
3. Form—rangy, deep, lithe, angular	4
4. Quality—bone clean, dense, fine, yet indicating substance, tendons and joints sharply defined, hide and hair fine, general refinement	4
5. Temperament—nervous, active, disposition good, intelligent	4
Head and Neck.—7.	
6. Head—size and dimensions in proportion, clear cut features, straight face line, wide angle in lower jaw	1
7. Muzzle—fine, nostrils large, lips thin, trim, even	1
8. Eyes—prominent orbit; large, full, bright, clear; lid thin, even curvature	1
9. Forehead—broad, full	1
10. Ears—medium sized, fine, pointed, set close, carried alert	1
11. Neck—long, lean, crest well defined, extended carriage, well cut out in the throttle, head well set on	2

	Count
Forehand.—23.	
12. Shoulders—long, oblique, smooth	2
13. Arms—short, muscular, carried well forward	1
14. Forearm—long, broad, muscular	2
15. Knees—straight, wide, deep, strongly supported	2
16. Canons—short, broad, flat, tendons sharply defined, set well back	2
17. Fetlocks—wide, tendons well back, straight, well supported	2
18. Pasterns—long, oblique (45 degrees), smooth, strong	2
19. Feet—large, round, uniform, straight, slope of wall parallel to slope of pastern, sole concave, bars strong, frog large, elastic, heels wide, full, one-third height of toe, horn dense, smooth, dark color	6
20. Legs—direction viewed from in front, a perpendicular line dropped from the point of the shoulder should divide the leg and foot into two lateral halves. Viewed from the side, a perpendicular line dropped from the tuberosity of the scapula should pass through the centre of the elbow-joint and meet the ground at the centre of the foot	4
Body.—11.	
21. Withers—well set up, narrow, extending well back	2
22. Chest—medium width, deep	2
23. Ribs—well sprung, long, close	2
24. Back—short, straight, strong, broad	2
25. Loins—short, broad, strongly coupled	2
26. Flank—deep, full, long, low under line	1
Hindquarters.—31.	
27. Hips—broad, round, smooth	2
28. Croup—long, level, smooth	2
29. Tail—set high, well carried	1
30. Thighs—full, muscular	2
31. Stifles—broad, full, muscular	2
32. Gaskin—broad, muscular	2
33. Hocks—straight, wide, point prominent, deep, clean cut, smooth, well supported	6
34. Canons—short, broad, flat, tendons sharply defined, set well back	8
35. Fetlocks—wide, tendons well back, straight, well supported	2
36. Pasterns—long, oblique (50 degrees), smooth, strong	2
37. Feet—large, round (slightly less than in front), uniform, straight, slope of wall parallel to slope of pastern, sole concave, bars strong, frog large and elastic, heels wide, full, one-third height of toe, horn dense, smooth, dark color	4
38. Legs—direction viewed from the rear, a perpendicular line dropped from the point of the buttock should divide the leg and foot into lateral halves; viewed from the side, this same line should touch the point of the hock and meet the ground some little distance back of the heel. A perpendicular line dropped from the hip-joint should meet the ground near the centre of the foot	4
Way of Going.—16.	
39. Walk—long, free stride	6
40. Trot—long, rapid, straight, reachy stride	10
Total	100

Heavy Horses.—The farmer is apt to be more interested in the draft horses. These are classified into breeds according to their ancestry and the places where they originated. We have the Clydesdale from Scotland, the Shire from England, the Belgian and the Percheron from France. Of these the Percherons seem to be gaining most in the favor of the American farmers. There is a historical reason for this, and this historical account illustrates nicely why we wish to know the historic origin of the breed we select. The French had a heavy draft

FIG. 41.—Draft horses showing good form, weight, quality, and action.

horse but, like other European horses, it was lacking in movement and staying qualities. In order to get a horse to draw their cannon in war times, the French rulers had the native French horse crossed with a horse from Arabia and from that cross they selected or, rather, bought their war horses. This gives us the most active of the large horses. In America, distances are long, we must travel over territory to fields and markets, hence we like the Percherons on our farms. They are equally good horses for the city express and coal wagons (Fig. 41). This does not mean that there are no other good horses; the Clydesdale and the Shire have their friends who will not admit

that the Percherons are the best horses. As with the light horses, we should score the horse that is most popular in the district, but we should score one heavy horse in order to know how a draft horse differs from a light horse.

DRAFT HORSE SCORE CARD

[From "Productive Horse Husbandry."—GAY]

	Count
General Appearance.—16	
1. Weight	
2. Height	
3. Form—low station, wide, deep, compact, massive	4
4. Substance—bone ample, joints broad, proportioned to scale....	4
5. Quality—bone dense and clean, tendons and joints sharply defined, leg broad and flat, hide and hair fine, refinement of head, finish	4
6. Temperament—energetic, disposition good, intelligent........	4
Head and Neck.—7.	
7. Head—size and dimensions, in proportion, clear cut features, straight face line, wide angle in lower jaw	1
8. Muzzle—broad, nostrils large but not dilated, lips thin, even, trim	1
9. Eyes—prominent orbit; large, full, bright, clear; lid thin, even, curvature	1
10. Forehead—broad, full	1
11. Ears—medium size, fine, pointed, set close, carried alert	1
12. Neck—long, muscular but not thick, well crested, throttle well cut out, head well set on	2
Forehand.—24.	
13. Shoulders—long, sloping, smooth, muscular	2
14. Arm—short, muscular, elbow in	2
15. Forearm—wide, muscular	2
16. Knees—straight, wide, deep, strongly supported........	2
17. Canons—short, broad, flat, tendons sharply defined, set well back	2
18. Fetlocks—wide, tendons well back, straight, well supported ..	2
19. Pasterns—long, oblique (45 degrees), smooth, strong	2
20. Feet—large, round, uniform, straight, slope of wall parallel to slope of pastern, sole concave, bars strong, frogs large and elastic; heels wide, full, one-third height of toe; horn dense, smooth, dark color	6
21. Legs—direction viewed from in front, a perpendicular line dropped from the point of the shoulder should divide the leg and foot into two lateral halves. Viewed from the side, a perpendicular line dropped from the tuberosity of the scapula should pass through the centre of the elbow-joint and meet the ground at the centre of the foot.	4

	Count
Body.—11.	
22. Withers—well defined but muscular	2
23. Chest—wide, deep	2
24. Ribs—well sprung, long, close	2
25. Back—short, straight, strong, broad	2
26. Loin—short, broad, strongly coupled	2
27. Flank—deep, full, long, low under line	1
Hindquarters.—32.	
28. Hips—wide, level, muscular	2
29. Croup—long, level, muscular	2
30. Tail—attached high, well carried	1
31. Thighs—deep, muscular	2
32. Stifles—broad, thick, muscular	2
33. Gaskins—wide, muscular	2
34. Hocks—straight, wide, point prominent, deep, clean cut, smooth, well supported	6
35. Canons—short, broad, flat, tendons sharply defined, set well back	2
36. Fetlocks—wide, tendons well set back, straight, well supported.	2
37. Pasterns—long, oblique (50 degrees), smooth, strong	3
38. Feet—large, round (slightly less than in front), uniform, straight, slope of wall parallel to slope of pastern, sole concave, bars strong, frog large, elastic; heels wide, full, one-third height of toe; horn dense, smooth, dark color	4
39. Legs—direction viewed from the rear, a perpendicular line dropped from the point of the buttock should divide the leg and foot into lateral halves; viewed from the side, this same line should touch the point of the hock and meet the ground some little distance back of the heel. A perpendicular line dropped from the hip-joint should meet the ground near the centre of the foot	4
Way of Going.—10.	
40. Walk—straight, strong, active	6
41. Trot—powerful, free, moderate action	4
Total	100

Classification of Cattle.—Cattle are classified into two and some give three types—beef, dairy and dual-purpose. Among the beef breeds are the Shorthorns, Aberdeen Angus (Fig. 42), Galloway, Herefords; among dairy breeds are Holstein (Figs. 43, 44), Jersey (Figs. 45, 46), Guernsey (Figs. 47, 48), and Ayrshire (Fig. 49). The Brown Swiss, Devon and Red Polled are classed as dual-purpose by some and by others according to types as dairy or beef. There is a very great difference in type between the dairy and the beef animal. The dairy animal is to give the energy derived from her feed to organs and parts of her body below a line running through the middle of

the cow; a beef animal is to lay on meat above the middle line. The dairy cow is to have three or four wedges to her form; the beef animal is to be a square prism or a cylinder with the corners rounded off slightly. The score card used for a beef animal is as follows:

BEEF CATTLE SCORE CARD

[From "Productive Farming."—DAVIS].

	Perfect Score.	Student's Score.
GENERAL APPEARANCE.		
1. WEIGHT, estimated ....lbs......... according to age......................	6	
2. FORM, straight top-line and under-line; deep, broad, low, set stylish..................	10	
3. QUALITY, firm handling: hair fine; pliable skin; dense bone; evenly fleshed..............	8	
4. TEMPERAMENT, quiet.......................	5	
HEAD AND NECK.		
5. MUZZLE, mouth large; lips thin; nostrils large..	1	
6. EYES, large, clear, placid...................	1	
7. FACE, short; quiet expression................	1	
8. FOREHEAD, broad, full......................	1	
9. EARS, medium size, fine texture.............	1	
10. NECK, thick, short; throat clean.............	2	
FOREQUARTERS.		
11. SHOULDER VEIN, full.......................	3	
12. SHOULDER, covered with flesh, compact on top; snug..................................	4	
13. BRISKET, advanced, breast wide.............,	2	
14. DEWLAP, skin not too loose and drooping......	1	
15. LEGS, straight, short; arm full; shank fine, smooth...............................	3	
BODY.		
16. CHEST, full, deep, wide; girth large; crops full..	8	
17. RIBS, long, arched, thickly fleshed...........	8	
18. BACK, broad, straight......................	8	
19. LOIN, thick, broad	6	
20. FLANK, full, even with under-line............	4	
HINDQUARTERS.		
21. HIPS, smoothly covered; distance apart in proportion with other parts.................	4	
22. RUMP, long, even, wide, tail head smooth, not patchy	5	
23. PIN-BONES, not prominent, far apart..........	3	
24. THIGHS, full, deep, wide....................	3	
25. LEGS, straight, short, shank fine, smooth......	2	
Total.................................	100	

FIG. 42.—Beef type.

FIG. 43.—A national champion Holstein bull.

Fig. 44.—A many-times champion Holstein cow. Notice splendid shaped udder, milk veins, large nostrils, fair lung capacity but lack of dairy conformation.

Fig. 45.—Champion Jersey. Sophie 19th of Hood Farm, Lowell, Mass.

FIG. 46.—A two-year-old champion Jersey. Pogis 99th of Hood Farm, Lowell, Mass.

Owned by Chesterbrook Farm, Berwin, Pa.

FIG. 47.—May Rilma. Champion Guernsey cow, 1073.41 lbs. butter fat in 365 days.

Fig. 48.—Billy's France of The Hague Imp. The highest priced Guernsey bull yet sold.

From "Productive Farming" (Davis).

Fig. 49.—Pure-bred Ayrshire cow. (Experiment Station, N. J.)

THE FARMER'S DAIRY-COW SCORE CARD

Things That Indicate a Good Producing Dairy Cow

	Counts
I. *A Strong Constitution* (20 *points*).	
Indicated by:	
1. Deep chest, spare shoulders, giving large lung capacity	10
2. Large prominent windpipe, giving large air inlet	1
3. Large nostrils, giving also large air inlet	1
4. Full and large heart girth, full in fore-flank, full in crops and back of shoulders, giving large heart capacity	4
5. Large navel	1
6. Large, full, bright eyes, slightly dished face	1
7. Mellow, loose, pliable skin	1
8. Bright appearance, calm and resolute carriage	1
II. *Large Efficient Digestive Capacity* (20 *points*).	
Indicated by:	
9. Deep, wide, full, and medium-long barrel, ribs broad and wide apart, broad, long, and not too sloping loins	14
10. Large, wide mouth, not peaked	1
11. Loose, mellow, medium-thick skin, yellow secretion, hair soft and fine	5
III. *Good Blood Circulation* (20 *points*).	
Indicated by:	
12. Large, branching, crooked and long mammary veins	5
13. Large and numerous milk wells	2
14. Long, wide-spreading and well-defined escutcheon	2
15. Loose, mellow, healthy skin	1
16. Lean, healthy, bright appearance, large, bright eyes and well-carried ears	5
17. Prominent, straight, open-jointed backbone, reasonably straight to, and at tail setting	2
18. Wide forehead, not too heavy in throat-latch and jawbone	3
IV. *Large Udder Capacity* (30 *points*).	
Indicated by:	
19. Front of udder extending well forward and under abdomen	7
20. Udder extending well back and hung high at escutcheon	7
21. Udder not fleshy, wide and level on under line	3
22. Four fair-sized, symmetrically-shaped teats	4
23. Thighs flat, wide apart, giving a roomy twist	2
24. Cow wide and level over hips, rump and pin bones, and having long rump	7
V. *Symmetry and Beauty of Form* (10 *points*).	
Indicated by:	
25. General appearance of cow as a whole	10
A perfect cow	100

May Rilma.—Figure 47 is a picture of May Rilma, the world's champion Guernsey milk cow. She gave in one year (365 days) 19,673 pounds of milk containing 1073.41 pounds of butter fat. During that time she was fed 16,892 pounds of feed and she drank 27,000 pounds of water. She was fed daily 18 pounds of grain mixture, 30 pounds of ensilage, 16 pounds of carrots, and what alfalfa leaves she would eat. The grain mixture consisted most of the time of 250 pounds of wheat bran, 50 pounds each of hominy, cottonseed meal, ground oats, and oil meal, 100 pounds of gluten feed, 3 pounds of beet pulp and 2 pounds of molasses. She was in her seventh and eighth years when she beat the world's record by something over 20 pounds of butter fat, and she gained in weight through the year.

Class Work vs. Home Projects.—Teachers should not fail to distinguish the difference between things that can best be done as class-room exercises and things that can best be done as home projects. Here is in part the difference between theory and practice. It is easy, for instance, to tell how an animal should be housed and fed. It is hard, exceedingly hard, to tell just how an animal should be cared for. There are so many things to tell. The mind of the pupil does not value the details, but let him have a home project, let his animal get sick or get off feed, and that same pupil is keen to learn what is best to do. Then when his questions are answered, whether by the teacher or by a book, the answers are assimilated and made part of his experiences from which he may draw conclusions and from which he may act in the future. Stock judging is good class work. Numbers add enthusiasm. It is easy to say that we are to see who will score the nearest correctly. That adds to the enthusiasm that comes from a contest, and really some boys are whole boys only when they are in a contest. Then their minds are most alert. Again, it is easy for a teacher to arrange with other schools for judging contests and then she is able to say to her pupils, "We wish to learn who are the three best judges to represent us in a contest with the other school."

But when we come to building an individual hog house, to caring for a sow and her pigs, to feeding the pigs so as to make pork at the lowest cost, to keeping accurate account of time and feed, we have things that are best done by individuals as home projects. But the experiences gained while handling home

projects make rich material for lessons in drawing, English and reading. We have been making the mistake heretofore of not finding a place for the home project experiences in the school work.

Things Not Worth Teaching.—There is little if any value to a pupil from learning the names of the different breeds of animals. Such work is as dead and lifeless as much of our work in geography. If sheep are not kept in a district, there is little to be gained from a study of the different breeds of sheep. If a certain breed of hogs is not kept in the district, unless the teacher wishes to have them introduced for some very good reason, there should be little if any time spent on the names and characteristics of that breed. But if a child comes from a farm where a certain breed is kept then it is worth while for the children, as part of their booklet work, to look up the origin, history, characteristics, advantages and disadvantages of the breed kept at home.

Types and Breeds of Swine.—There are two types of swine—the bacon and the lard types. The bacon is a lean type, should be an active hog and grown on pasture and a narrow protein ration. The lard hog is, like the beef cattle, a round, fat animal. The body should be a square prism or a cylinder with the sides slightly flattened. Among the bacon breeds, the Tamworth is a leader. Other breeds are the Large Hampshires and the Large Yorkshires. European laborers do not use butter three times a day as we do in America. They use a slice of bacon between two pieces of bread for at least two meals a day. This makes the meat of the bacon hog in demand in Europe. For supplying this market the Danes are far ahead of us in America, and yet we can produce a pound of pork for less than the Danes can.

The fat hog is popular in America. We can get nearly as much for the lard considering what it costs us as we can for the lean meat or bacon. Among the lard hogs are the Chester Whites, the Duroc-Jersey, the Poland China, the Berkshire, and smaller Hampshires.

Alfalfa pasture makes the best place on which to raise pigs. They need milk while young and corn when older to supplement the alfalfa. The hog is not as dirty an animal as man forces it to be. Naturally it ranged the woods and lived on

acorns, nuts and roots. There is no good reason why we should try to raise our hogs in small, filthy pens.

Judging Hogs.—Judging swine, like judging other animals, is selecting. We aim to select the animal that will grow most on a given amount of feed, the animal that will "dress" the most, and hence bring the highest price.

FAT HOG SCORE CARD

[From "Productive Swine Husbandry."—DAY]

		Counts
A.	GENERAL APPEARANCE:	
	Size—Well developed for age	5
	Form—Deep, thick, smooth, low set, good length, but compactly built, standing on well-placed legs. Top line straight, or slightly arching; under line, straight; belly, trim and neat	10
	Quality—Hair, fine; skin, smooth, showing no tendency to wrinkle; bone, clean and fine; flesh, smooth and mellow but showing no flabbiness	10
	Condition—Deeply and evenly covered with flesh, but not overdone for the purpose for which the animal is intended	6
	Style—Active and sprightly, walking without a swaying movement, and standing well up on toes. Breeding animals should show strong character	4
B.	HEAD AND NECK:	
	Snout—Moderately fine	1
	Face—Broad between eyes; poll, broad and full	1
	Eyes—Good size, full, and bright	1
	Jowl—Full, broad, deep, smooth, and firm, carrying fulness back near to point of shoulder	2
	Ears—Medium size, fine, and soft	1
	Neck—Short, thick, and deep. Rounding and full from poll to shoulder top	2
C.	FORE QUARTERS:	
	Shoulders—Broad and compact on top, deep, well fleshed, blending smoothly with neck and body	6
	Breast—Wide, deep, and full	3
	Fore Legs—Set well apart, short, tapering, and straight; pasterns, upright; bone, clean and fine; feet, medium size and strongly formed	3
D.	BODY:	
	Back—Broad, straight or very slightly arched, medium length, uniform width from shoulder to ham, thickly fleshed, even and smooth, without creases or projections	8
	Loin—Broad, strong, full, and thickly and smoothly fleshed	5
	Ribs—Long and well sprung	4
	Side—Medium length, deep, smooth, even between shoulder and ham	6
	Heart Girth—Large, full back of shoulder, and deep and full at fore flanks	5
	Flank—Deep and full	2

E. HIND QUARTERS:	Counts
Rump—Same width as back, long, smooth, slightly rounded from loin to base of tail	4
Ham—Broad, deep, heavily fleshed, plump, and reasonably smooth; flesh carried well down to hock on inside as well as at rear ..	8
Hind Legs—Short, straight, set well apart and squarely under body; bone, fine and clean; pasterns, strong; feet, medium size and strongly formed	3
Total	100

Sheep.—Sheep may and may not be worth teaching, not that the sheep industry is not important, but there is more than we can teach which is of vital economic importance. If sheep are kept in the district, or if they should be kept because they would pay, then sheep are worth teaching. A discussion of what kind of sheep would pay best, how the farms would have to be fenced, how the sheep could be protected from the dogs, how the sheep must be housed, whether there is a probability that the price of land, labor, the skill of the labor and the climate will enable one to keep the sheep at a profit, and whether the farmer will enjoy making money by keeping sheep as much as he would by doing something else —all of these must enter into consideration before we are sure that he should go into the sheep business.

From "Productive Farming" (Davis).

FIG. 50.—Champion Southdown ewe, one of the most popular of the medium wooled breeds.

Sheep are kept for two purposes, mutton and wool, and hence there are two types of sheep. The wool sheep are again classified into the coarse-wooled breeds—Leicester, Cotswold and Lincoln; medium-wooled sheep—the Dorset, Southdown, Hampshire, Oxford, Cheviot and others; and fine-wooled—Merino, Delaine, Ramboullet, American Merino and others.

The popular sheep in eastern America are the Southdown (Fig. 50) and the Shropshire (Fig. 51), both fairly good mutton sheep and medium coarse-wooled sheep. Both have lambs that are fairly round and plump and hence ready for market at almost any time.

If the farm is fenced so as to hold sheep and if the laws and public opinion are such as to insure a farmer reasonable protection from dogs, a few sheep may be profitable to keep for the help they may be in keeping down weeds. Sheep consume many weeds which horses and cattle do not eat. Where there is brush land on the place, farmers have found it profitable to keep Angora goats, for they eat off the leaves and small shrubs.

From "Productive Farming" (Davis).

Fig. 51.—Prize-winning Shropshire wether one year old. (Experiment Station, Wis.)

Judging at the Shows and Fairs.—"The old world is far in advance of America," says Grubb, "in some features of agricultural exhibitions. There shows are held for agricultural exhibits alone, without the disgusting so-called 'attractions' and fake shows that characterize so many American fairs." School teachers above all people must help to bring about that day when we too can have pure agricultural fairs. Now the agricultural press is almost the only agency working for better fairs. But we can hardly expect that our people will enjoy judging until more institutions than our State colleges teach their pupils how to judge. Teachers, everywhere that agriculture is taught, should use the local corn shows to create interest in judging critically. And teachers, of all people, should not judge unless they use the score cards, for that is the only way that we now have of judging critically. Potatoes and bread are frequently

shown at the corn shows along with the corn. We need many more capable judges of both potatoes and bread.

U. S. TOMATO SCORE CARD—FRESH AND CANNED

Fresh Tomatoes

		1	2	3	4	5	6	7	8	9	10
1. Yield of fruit, in pounds	40										
2. Size—medium and uniform rather than very large	10										
3. Color—normal for ripe fruit	10										
4. Uniformity of samples—smoothness, size, color and shape	20										
5. Shape and smoothness—freedom from cracks and surface blemishes	10										
6. Evenness of maturity	10										
Total score	100										

Canned Products

		1	2	3	4	5	6	7	8	9	10
1. Color when cooked	40										
2. Quality of canned product, color, pulp, firm—whole or cooked	40										
3. Number of cans per bushel	10										
4. Weight of cans and percentage of pulp	10										
Total score	100										

POTATO SCORE CARD

External examination:	Points
1. Size, large or small, even or uneven	20
2. Shape, flattened spheres preferred	10
3. Appearance, bright, clean, free from scab	60
4. Quality, sound, not too spongy	10
	100
Knife examination:	
1. Smoothness	5
2. Pares thin	10
3. Flesh white	5
4. Sound, not hollow	5
5. Cortical layer thick	10
6. Centres small and not watery	15
	50

Table examination:	Counts
7. Quickness of cooking	5
8. Potatoes, cooking alike	10
9. Mealiness	20
10. Whiteness	5
11. Grain when mashed, fine	5
12. Flavor	5
	50

The following is the bread score card used at many shows and in many short courses:

BREAD SCORE CARD

Scale of points	Perfect score				
1. Flavor	20	......	......	......	......
2. Lightness	10	......	......	......	......
3. Sweetness	15	......	......	......	......
4. Texture and grain	20	......	......	......	......
5. Color	5	......	......	......	......
6. Crust	5	......	......	......	......
7. Shape and size	5	......	......	......	......
8. Doughiness and moisture	20	......	......	......	......

CORN SCORE CARD

	Counts					
Will it Grow?	40		......	......	......	......
1. Has It Vitality?		20	......	......	......	......
2. Did It Mature?		20	......	......	......	......
Will it Yield?	45		......	......	......	......
3. Shape and Size of Ears		15	......	......	......	......
4. Filling of Butts and Tips		5	......	......	......	......
5. Straightness of Rows		5	......	......	......	......
6. Uniformity of Kernels		5	......	......	......	......
7. Shelling Percentage		15	......	......	......	......
Does it Show Improvement?	15		......	......	......	......
8. Color of Grain		2	......	......	......	......
9. Color of Cob		2	......	......	......	......
10. Shape and Dent of Kernel		5	......	......	......	......
11. Arrangement of the Rows		1	......	......	......	......
12. Breed Type		5	......	......	......	......
		100				

HOW TO USE THE CORN SCORE CARD

Will it Grow?—Has it vitality? This is answered by three other questions: (1) Is it free from mould? (2) Is the germ white and free; *i.e.,* not yellow, soggy and sticking to the walls? (3) Do you know that it did not freeze while damp and sappy?

Did it mature? This is told by the firmness, lack of sappiness, lack of blisters under the kernel skin and a lack of an excess of crown starch.

Will it Yield?—To yield well corn must produce as large an ear as will mature in the given locality; for places west of Philadelphia, this requires ears from nine to ten inches long and from 6½ to 7½ inches in circumference. Each ear should have a well-filled tip and butt, and the kernels on the tip and butt as well as along the sides of the ear should be of uniform size and shape, so as to pass through the planter at an even, uniform rate. Irregular kernels mean an uneven stand. The straight-

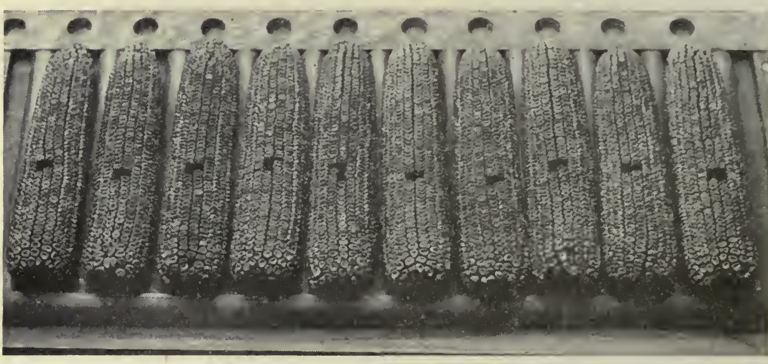


FIG. 52.—Grand champion ten ear entry, 1913 National Corn Show. Reid's Yellow Dent.

ness of the rows does much to insure the evenness of size and shape of kernels. The lower one-third of the kernel is worth the outer two-thirds, and the lower one-third adds very much to the weight. Shelling percentage is determined by a well-filled tip and butt, blocky, dull, wedge-shaped kernels, absence of shoe-peg-shaped kernels and length of kernel compared with diameter of ear.

Does it Show Improvement?—This is told by the good, rich, uniform color of kernel and cob, good and uniform-shaped kernels, with regular and sufficient dent, with rows arranged or paired according to the prevailing ears of the breed or type, and with kernels and ears that show the characteristics of the better ears which the breeder has had in mind for years past.

Betting a Danger.—There is always danger that the contests and corn shows will fall under the baneful influence of the

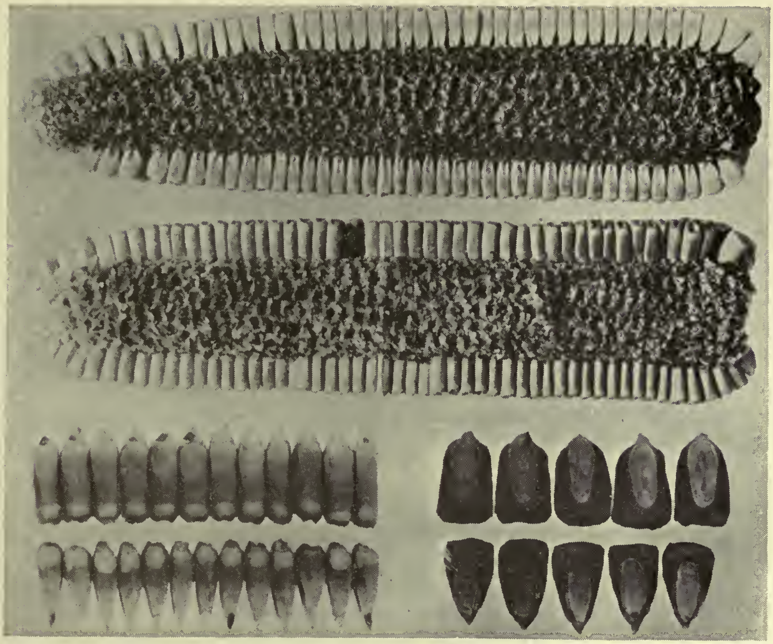
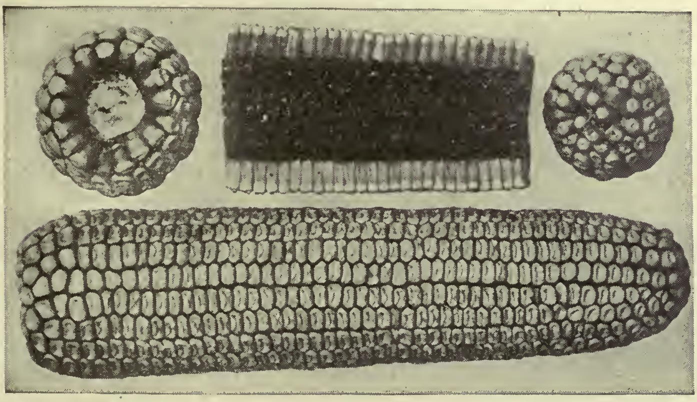


FIG. 53.—What the corn judge looks for. A poor ear and a good ear of corn. The lower kernels are from the upper ear. Avoid shoe-peg-shaped kernels and spaces between kernels at the cob. Oil and protein are in the thick wedge-shaped kernels.



From Productive Farming (Davis).

FIG. 54.—Good seed corn. The upper ear shows good even rows with very narrow spaces between rows and between kernels. The tips of the cob should be covered with corn. There is a good deep impression and small stem shown at the left. The kernels are deep as compared with the size of the cob, as shown. (U. S. Farmers' Bulletin 229.)

sporting element. Teachers must do all in their power to guard against this. We must ask first for the things that a real farmer needs most. Some of our corn score cards ask, first, Is it true to type?—and by so doing they place the emphasis on the fancy points. What a farmer wants to know of an ear of corn which he is to plant is, Will it grow? Will it yield? Does it show improvement? The score card (p. 109) is one used at the national corn shows. The order of points and relative values have been changed. Some may think that straightness of rows and uniformity of kernels are fancy points, but when it is remembered that we plant with machinery and that the lower one-third of a kernel may be equal in feeding value to the upper two-thirds, we realize that these are not fancy points. The boy who hopes to win at the corn shows should make a corn board (Fig. 55) and place ten ears on it, then study the ten ears as one would study a

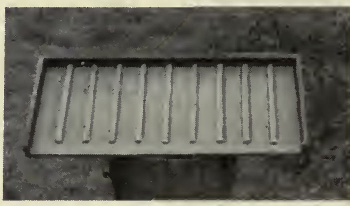


Fig. 55.—The corn board.

lesson from a book. In many of our schools, each pupil is required to make a corn board as part of his manual training work. The corn board has the three attributes of a first rate manual training undertaking: First, it is as complex as the pupil requires; that is, it offers opportunity for blue prints, for the tool processes of marking, sawing, planing, nailing, surfacing, etc. Second, it offers the beginner a chance to make something which he needs for his work in school. Third, the corn board offers an object which the pupil will find useful in the home after he leaves school. If holes are bored in a strip and the strip nailed at the upper edge, the holes make serviceable places in which to keep the kernels (Fig. 52). When farmers wish it, the school should help the farmers to select their ten best ears for the corn shows. Fig. 15 is a picture of the West Chester State Normal School pupils judging corn in order to select the best ten ears for the farmer to send to his corn show in another

county. It is not easy but it is possible at times to use contests for coöperation, paradoxical as that may seem. But this is the team work advocated above. We pass naturally from team work to club work and from club work to community work. Our talent for judging is not worth developing unless we can put it to human service.

QUESTIONS AND STUDIES

What have you learned about:

1. The origin of the score card?
2. What a score card is? How and when to use it?
3. The modern tendency toward standardization?
4. Are there farmers in your district who know how to use DeVries' law of mutation?
5. Do the farmers of your district know how to use the laws derived from Mendelism?
6. How far do the requirements of the score card influence the prices of light horses in your district?
7. What are the attributes of a good draft horse? Do the best draft horses in your district conform to the requirements of the score card?
8. What are the attributes of a good dairy cow? Have the leading dairy cows in your district these attributes?
9. Which do the farmers of your district use the more intelligently, selection or breeding?
10. What are the attributes of a good ear of corn?

References.—Bulletin No. 61, Bureau of Animal Industry, U. S. Department of Agriculture, The Score-Card in Stock Judging; Bulletin No. 37, Bureau of Animal Industry, Market Classes of Horses; Farmers' Bulletin No. 106, Breeds of Dairy Cows; Circular No. 113, Bureau of Animal Industry, Classification of American Carriage Horses; Farmers' Bulletin No. 51, Standard Varieties of Chickens; Articles on Judging in Cyclopedia of Agriculture; Chapter XI, Gay's Productive Horse Husbandry; Plum's Animal Husbandry; Harper's Animal Husbandry; Davis' Productive Farming. C. H. Lane, specialist in Agricultural Education at Washington, writes that he is preparing a bulletin on The Use of the Score-Card in Schools.

The eye of the master fattens the cattle.—AN OLD ENGLISH ADAGE.

The feeding of stock is both an art and a science. . . . In an effort to make feeding an exact science, there is danger of losing the art.—GAY.

The economic feeding of farm animals involves a knowledge of the principles underlying the practice. The better knowledge one has of the feed, its source, use, composition and digestibility, the more familiar one is with the functions of the various feed materials, and the balancing of rations, the more intelligently can one choose the foods that constitute the ration.

Before the days of scientific investigation in this field, long-continued experience in feeding animals had resulted in many precepts . . . some of which were undoubtedly sound. What has been accomplished in building up a body of knowledge. . . . We have acquired a somewhat extended knowledge of the compounds. . . . Extensive determinations have been made of the digestibility and availability of feeding-stuffs. . . . Fruitful results have come from the long-continued investigations as to the functions of feed compounds in building up and maintaining the animal body. . . . By the use of the respiration calorimeter, with which it is possible to measure the income and outgo of the animal body and the heat production as well, it has been learned that the principle of the correlation and conservation of energy holds good in the maintenance and operation of the living mechanism.—JORDAN in "Cyclopedia of Agriculture."

CHAPTER V

FEEDS AND FEEDING

Mathematics and Business Ability.—The successful farmer surpasses the unsuccessful very largely because he has more business ability, and business ability in the new agriculture is to be increasingly a matter of mathematics. Probably the most important discovery ever made by the human mind was when, peering into nature, it found order there, and that order is what we call the multiplication table. But what does this priceless heritage profit us unless the developing mind is brought into contact with it, and held in contact with it, until the mind works with ease and precision? "No one," says Hazlitt, "is idle who can do anything. It is conscious inability, or the sense of repeated failure, that prevents us from undertaking, or deters us from the prosecution of any work."

The Feeding Tables are the Mathematicians' Most Valuable, Recent Gifts.—Among the most valuable gifts which the mathematicians have given to the world in recent years are the feed tables by which one may determine with almost mathematical accuracy just what an animal should have in order to enable it to perform its functions most satisfactorily. And yet again, what does this inheritance amount to unless the mind is brought into contact, and held in contact, with the feed tables until it becomes a pleasure to work problems with them? But we must not forget that the foundation for pleasure and profit in using the feed tables comes from a mastery of the fundamental processes. When our teachers become conscious of this growing importance of mathematics, and when from their study of agriculture they become conscious of the innumerable applications of mathematics to be found in the new agriculture, they will teach their work in arithmetic and other branches of mathematics with renewed enthusiasm and will impart some of their enthusiasm for mathematics to the coming generation. If the introduction of agriculture into the public schools does not help the teaching of the common branches, especially arithmetic, then something is wrong with the agriculture.

I am not alone of the opinion that the time has come when

we must have a new arithmetic to accompany the new agriculture. Professor Bailey says: "The student usually receives no training farmward until he enters college. At that time his sympathies are likely to be set toward other enterprises. The common schools have not trained countryward. So far as they train for college it is mostly in the direction of arts and sciences or letters. If the youth is to be trained countryward, the training should be begun before he is sent to college. These remarks are well illustrated even in arithmetic, which presents chiefly storekeeping, middlemen, partnership, and theoretical problems; and yet there are hundreds of indigenous farm problems, the figuring of which in the public schools would revolutionize agriculture."

Feeding is Winter Work.—During the winter months, farmers are engaged much of their time in feeding, and in order to be most successful they must know with mathematical certainty what they are getting for their feed. How many pounds of corn does it take to make a pound of hog or beef? What does it cost to keep a horse or colt during the winter? What relative weights of the different feeds should be mixed for the different animals? What does it cost per day to feed a dairy cow? What feed mixture comes nearest insuring a maximum milk flow? What cases in arithmetic are used in solving these problems? These and similar questions are the ones that farm children should be asked during the winter months, and they should be taught how to find with ease and pleasure answers to each and every similar question.

Feed Tables More Important than Interest Tables.—Pupils who can work problems in percentage can work problems with the feed tables. But as stated above, in order to work such problems with pleasure during the stormy winter days and evenings, the farmer must have had his mind brought into contact with such problems, and must have had his mind held there until it works with ease and precision. This will give interest and enthusiasm which come from early formed habits. Before the growing gap between the school and the home is closed, teachers must learn that there is more danger of a man's being cheated by nature than by his merchant or banker. Before the arithmetic necessary for the new agriculture can be introduced into our schools, we shall have to impress parents with the fact that a man can buy for twenty-five cents a little book that will do

one's figuring with the coal man, the grain buyer, the interest reckoner, and the creamery, but there is no book that can do our reckoning with Nature. Then, too, the law compels the banker or merchant to rectify his mistake, but Nature never rectifies a mistake. Nature is absolutely just, but she often charges a farmer one of the best of his horses, cows, hogs or a member of his sheep or poultry flock for a single error in feeding. Nature more often charges a man his profits for months for a continued series of errors in feeding, and the most pathetic part of it all is that the unsuccessful farmer is ignorant of the symbols or language with which Nature can tell him he is losing. This is so because he was not put into possession of that language when he was a boy.

Begin with Something General and Practical.—While there is danger of error in the work with the feed tables and the mathematical subjects, yet there are many interesting and valuable things of a general nature which the teacher need have no fear in presenting. While the study of agriculture is so new to the schools, we may begin by using these general subjects for opening exercises or for regular lessons. Girls may need to be cautioned that their happiness may depend, quite as much as the boys', on their having a clear understanding and a keen appreciation of the importance of this knowledge. Domestic animals and man are so much alike that the work in feeding makes the study of physiology easier. In my teaching I have found the girls quite as interested in agriculture as the boys, and I have full confidence in the ability of our lady teachers to handle the subjects. Woman was the first to till the soil, to domesticate the animals, to build them places for protection and to provide for them during storms and winters. Therefore our lady teachers have but to arouse their dormant instincts and latent powers to find this work fully as interesting as do the men.

If we obey the educational principles, which say, "go from the known to the nearest unknown" and "a child remembers most easily when what he is trying to learn is connected with something which he already knows," we will introduce these lessons in agriculture on feeds and feeding by asking the pupils to make a list of the reasons why we need food. They will undoubtedly give the following: (1) to build up the tissues of the body, (2) to give heat, (3) to give energy. It is easy to lead

the children to see that the domestic animals need feed for the same reasons, and some animals need feed for a fourth reason—to make special products, as wool, eggs, meat, milk, etc.

Another lesson, or series of lessons, may follow the question: Why do we need a variety of foods? The answer will not come so readily, but some one will see that it is because our bodies are so complex and hence it takes many different ingredients to build up the various tissues and enable us to make the various secretions for digestion, nourishing the hair, nails, etc. Then it is easy to enable children to understand that the bodies of animals are made up of a number of different chemicals and compounds and nothing but the most varied food can build bone, muscles, nerves, skin, hair, cartilage, and furnish the different fluids and toxic poisons.

Professor Smith says: "Rations must not only furnish the necessary amount of digestible nutrients, but must also be palatable to the animal. This is especially true where rapid gains or large milk flow are desired. Hay should not be over ripe, discolored or mouldy; grain should not be musty, or ground and placed in heaps where it becomes tainted by decomposed oil. Feed boxes should be free from foulness. A ration becomes less palatable when limited to a few foods. A variety of foods is more appetizing and is therefore always desirable for all classes of animals, which applies to roughages as well as concentrates. The flow of digestive juices is augmented, and digestion made active, through the influence of palatability of food."

Provide Succulent Feed.—When we become fully conscious of what all this means, we realize that farm animals, as well as man, need some succulent and some dry feed every day of the year. This has taxed the ingenuity of man, but it is partially solved now by the use of roots or ensilage in the winter and of hay during the summer and in tropical countries. Probably no one thing in connection with feeds has been of greater value to the people of the northern States and periodically dry places than the invention of the silo (Fig. 56). And yet a desire for it and an understanding of its value are found in the consciousness of a very small percentage of our farmers.*

* This remark is well illustrated in Porto Rico, where the silo is much needed, and where the Experiment Station silo is the only silo in the island.

The Silo.—The silo is a large, airtight tank, in which green feed is placed. The chemical action soon heats the feed to near 170° F. and it remains at that temperature for some weeks. This makes the feed thoroughly cooked in a fireless cooker. The weight of the green material drives out the air except for a few inches around the edges and near the top. Hence the contents of the silo, which we call ensilage, is canned green feed. Teachers should send to their Experiment Stations for bulletins on the silo and read them, and also get the larger boys to read

FIG. 56.—Filling the silo in Florida. The silo may be used to hold succulent feed from Porto Rico to Canada.

them. The older farmers are not accustomed to think of or use the silo, therefore we cannot hope to get some of them to use it, but the boys should be taught to desire and to use ensilage in their feeding.

Correlate Weights and Measures with Feeding.—Another interesting series of lessons may be given on the topic of how much feed each of the different farm animals consumes per day and how much it should consume. What a world of interest connected with denominate numbers when the teacher leads the

pupils to use the tables while measuring and weighing things on the farm! I do not know of a more valuable exercise for the perceptive faculties than that which comes from a child's trying to estimate in pints, quarts, gallons, pecks, and pounds the different amounts of feed given to the different farm animals. How few farm boys are able to tell, with anything like accuracy, what a given fork full of hay will weigh! And yet how easy for a teacher, especially after the school yard is mown, to tie up a forkful in a rope and weigh it (Fig. 57). A gallon tin pail may be used for weighing the different grains and feeds, such as oil meal, bran, shorts, etc. The object is to enable the boy to tell by weight what he is feeding by measure.

Fig. 57.—The same scales used to weigh the milk may be used to weigh the feeds.

Correlate the Work with Reading, Spelling and Composition.—The work outlined so far in feeds and feeding may be given as part of the work in nature study. It will lose half of its value if the teacher neglects to have the children do some reading, writing, and have some spelling lessons on the words used. Blackboards, charts, leaflets, bulletins, and books may be used. Booklets may be made by the boys on the feeding of stock, while the girls make booklets on cooking and foods for the family. From this we are prepared to take up the lessons on the use of the feed tables and the feeding of the different farm animals.

Kinds of Feeds.—Feeds are variously classified. The farmer classes the stems and leaves which he feeds, such as alfalfa, corn fodder, hay, and pasture, as *roughage.* The feeds which he must buy and which are made in some kind of a mill he classifies as *mill-feeds.* The scientists put the mill-feeds and the cereals together and call them *concentrates.* If the natural plant moisture is present, we call the feed *succulent.* If the moisture is not present, we classify the feed as *dry feed.*

Farm boys should be taught to group their roughage together, get the ratio of protein to carbohydrates and the amount of dry matter, protein and carbohydrates in a hundred pounds and then treat their roughage as a unit. To the roughage they must add concentrates enough to feed the animal and hence the con-

centrates—grain and mill-feeds—may be mixed and also treated as a unit. This simplifies the mathematics very much.

In order to be able to think clearly what the feed is to do, we call some feed rich in protein or nitrogen. Protein is the most costly feed a man has to buy. It is the feed that builds muscle and hence is very necessary for growing animals, for animals doing hard work, and for the dairy cow that gives the protein in the form of casein in her milk.

Starches, fats, and oils are classed together as carbohydrates because carbon is the important element. In protein, the nitrogen is the important element. The carbohydrates give energy, heat and fat. Fat is concentrated carbohydrates. If we have fat or oil given, we reduce it to carbohydrates by multiplying it by two and one-fourth, and then adding the product to the carbohydrates. The sugars and starches we classify as carbohydrates.

Minerals.—Animals need mineral matter. There are fourteen or more elements that an animal needs. Of the minerals lime is probably the most important. We are just beginning to understand the rôle played by calcium. As stated in the chapter on soils, there are able scientists who believe that an excess of magnesium is poison to an animal and that calcium is necessary to balance the magnesium. The Wisconsin people are teaching that a dairy cow needs more calcium than we generally furnish. Some dairymen are feeding bone meal. The poultrymen have found that it is necessary to furnish much more calcium than hens ordinarily get from the shell which they use for grinding their food. Dr. Meltzer says of calcium: "Any abnormal effect which sodium, potassium or magnesium may produce, whether the abnormality be in the direction of increased irritability or of decreased irritability, calcium is capable of reëstablishing the normal equilibrium."

POULTRY FEEDING

Both Boys and Girls Interested in Poultry.—The subject of the feeding of poultry is one in which the girls should be as much, if not more, interested than are the boys. The teacher should aim to send the pupils home, especially in the spring time, with hearts filled with a desire to help poor, tired, worried mother, who generally has the care of the poultry and who only too often lacks the coöperation of the children after they begin

school. In Smith's chapter on "Poultry" we find, "Feed should not be given little chickens within 24 hours from time of hatching. Some poultrymen do not feed for 72 hours. The reason for this is, of course, that nature has provided a means of subsistence for the young chick until he has strength to help himself, by causing the absorption . . . into the abdomen of a portion of the egg designed for that purpose."

Give Little Chicks Mixed Feeds.—There are upon the market a number of mixed grain feeds which, if supplemented with milk and a little meat scrap, make a very good ration for little chickens. H. R. Lewis in "Productive Poultry Husbandry" says: "The feeding of the chicks is one of the most important factors in poultry keeping, and successful nutrition should begin with hatching and extend throughout the growing period. The first four weeks are the most trying, for this period covers the delicate stage of the chick's growth, and is the time when the death-rate is the greatest. . . . It is undesirable to force the chick to eat within a period of from forty-eight to sixty hours after hatching. The best practice is to supply plenty of water and fine grit when putting chicks in the brooder, withholding all solid feed for at least the first twelve hours in the brooder. A good plan is to give the chicks their first feed the morning after they are placed in the brooder."

It is unsafe to depend too much upon calculated standards, but the standards are guides that give us the flock's probable needs and are to be changed as the conditions of the chicks make necessary.

Rations for Laying Hens.—At the North American egg-laying contest, five hens were kept in each house. Each hen ate all that she cared to. The feed was fed two ways, one in the form of a dry mash which was placed in a crock with wire mesh over it so that the hens could not get on to it with their dirty feet. The other was a scratch feed, fed from an automatic feeder (Fig. 35). The two mixtures were as follows:

Dry mash	Scratch feed
200 pounds wheat bran.	60 pounds cracked corn.
100 pounds cornmeal.	60 pounds wheat.
100 pounds gluten feed.	40 pounds plump oats.
100 pounds ground oats.	20 pounds barley.
75 pounds middlings.	10 pounds kafir corn.
30 pounds fish scrap.	10 pounds buckwheat.
30 pounds beef scrap.	10 pounds coarse beef scrap.
28 pounds low-grade flour.	

The coarse beef scrap was made by sifting the ordinary beef scrap and putting the finest into the dry mash and saving the coarser for the scratch feed. All of the feeds were thoroughly mixed and fed once a week. From this feed they got an average of one hundred and seventy eggs from each of five hundred hens. The average per hen for the United States is about eighty eggs per year. It is not claimed that this is an economical feed. Some boy or some girl in the clubs is to show us how to get as many eggs on a more economical feed.

A Ration for One Hundred Hens.—A young lady in normal training at Humboldt College figured the following as the cheapest balanced ration which she could find for one hundred laying hens. If supplemented with plenty of grit and a little ensilage, alfalfa leaves or pasture it would seem to be a splendid standard. She found that one hundred standard sized Plymouth Rock hens would clean it up each day.

	Digestible dry matter	Protein	Carbohydrates	Cost
Wheat, 8 pounds	7.16	.70	5.66	$.15
Corn, 15 pounds	12.75	1.01	10.83	.15
Oats, 4 pounds	3.58	.43	2,35	.06
Milk, 30 pounds	2.82	.87	1.77	.06
Meat scraps, 1½ pounds	1.34	.90	.47	.03
	27.65	3.91	21.08	$.45
Standard*	27	4	24	

Uses of the Table.—This table is useful in a number of ways. It forms a standard by which we may measure what we are feeding. It gives us some idea of what it costs to keep one hundred hens up to full laying capacity. But the greatest value came from the growth of the young lady while she was making the table, measuring the feeds, and seeing whether the hens would clean up that much. So the teacher must remember that, educationally, the most valuable work with the feed tables will not be the getting of standards but the giving to the boys and the girls a working knowledge of how to get standards for themselves.

How Do We Make the Tables?—The texts on agriculture and the standard books and bulletins on feeding give feeding standards which have been found by hundreds of experiments to

* The reader is referred to Lewis' Productive Poultry Husbandry for the most reliable and up-to-date discussion of poultry feeding and feeding standards. This standard is taken from that book, page 175.

be the need of a given number of pounds of the different animals during each twenty-four hours. Then they have the digestible ingredients of the different feeds, which ingredients are generally given in percentages. We start with the amounts that some practical farmer or feeder near us is feeding, and from the tables we figure what his animals are getting from those amounts. We add these together, and if they come very near our standard we are satisfied. If they do not give us nearly enough or are in excess, we increase or lower the amount until we get a ration near our standard.

How to Learn to Make a Ration.—Any bright young man or woman can take the feed tables with the instructions for using them, as found in the little text-books on elementary agriculture, such, for example, as Davis's, Goff and Mayne's, Burkett, Stevens and Hill's, Halligan's or Warren's, and by giving from two to four hours of close, concentrated effort, attain a fairly good working knowledge of how to use the tables. A ration should be verified by the practice of some farmer or feeder before it is given to the children to carry home as a standard. Notwithstanding the difficulties and uncertainties, the time has come when no boy or girl should be permitted to graduate from the eighth grade of our public schools unless he or she can work any ordinary problem with the feed tables so as to get a fairly close balanced ration for any given number of animals.

FEEDING THE DAIRY COW

Place of the Dairy Cow in Modern Life.—Probably there is no other farm animal in which boys and girls are so vitally interested as in the dairy cow. Their health, happiness and often life itself depend upon intelligent care of this useful animal. No other food can be produced so economically as milk and butter. But the climate in some States is extreme, tuberculosis is prevalent, and a cow giving all of the fat of her feed into the milk pail is thin and hence easily chilled. Milk is made, however, largely from water and air. Farmers unconscious of this fact are apt to put the cow in what they call a "warm barn," which generally means a stable deficient in pure air, and only too often it means a stable where a cow is compelled to lie in her own filth. Recent investigations have shown that the best insurance against a cow's catching tuberculosis is

fresh air without draughts, and the best insurance of human beings against contamination from bovine tuberculosis is cleanliness. In Bulletin 99 of the Bureau of Animal Industry we read: "Milk from tuberculous cows with unaffected udders we believe to be free from infection until it becomes contaminated with feces or some other material that contains tubercle bacilli from outside the cows." Teachers cannot impress upon the minds of their pupils too strongly the fact that plenty of fresh air, a balanced ration and absolute cleanliness

FIG. 58.—Interior of modern barn; light and clean. Notice sawdust-asphalt bricks, which are dry, sanitary, and warm.

(Fig. 58) are necessary in order to make milk a fit food for human consumption.

Feed for the Dairy Cow.—How much feed, and what proportions are needed for an ordinary diary cow in full milk flow? In Smith's "Profitable Stock Feeding" we find (page 50): "Woll, of the Wisconsin station, made an average of the rations fed by fifteen successful dairymen of that State, comparing this with rations fed in Connecticut and New York. His investigations, founded on American feeding experience, lead to the conclusion that a 1000-pound cow in full milk flow requires per day 25.6 pounds of dry matter, containing digestible nutrients as

follows: protein, 2.2 pounds; carbohydrates, 13.3 pounds; and fat, .8 pounds; nutritive ratio, 1: 6.9."

This gives what is known as the *Dairy Standard.* Since the amount can only be reached approximately and since one pound of fat is equal to 2¼ pounds of carbohydrates, this may be reduced in round numbers to 26 pounds of digestible dry matter, from which come 2 pounds of protein and 14.5 pounds of carbohydrates, which gives us the ratio of 1: 7 as the requirement of each 1000 pounds of a dairy herd per day. This is known as a *medium ration.* A *wide ration* contains proportionately more carbohydrates or heat-producing matter. A *narrow ration* contains proportionately more protein. *Medium, wide* and *narrow* rations are terms that the boy and girl will meet frequently in their reading in the agricultural and domestic science papers, and hence the teacher should see that they are explained and repeated until thoroughly fixed in memory.

FIG. 59.—Milking machine at work.

The following is a fairly good ration for each 1000-pound cow in full milk flow. It will serve as a guide to follow reasonably close but to be varied according to prices and materials on

hand to feed. Children should try to find how near they approximate this ration in their feeding at home.

	Digestible dry matter	Protein	Carbohydrates	Cost
Alfalfa hay, 10 pounds	9.36	1.17	4.31	$.09
Ensilage, 30 pounds	7.92	.42	4.71	.09
Linseed meal, 2 pounds	1.80	.60	.95	.02
Mixed hay, 10 pounds	8.70	.42	3.32	.08
Totals	27.78	2.61	13.29	$.29
Standard	26	2	14	
Variation	+1.78	+.61	−.71	

Human Foods.—This chapter would be incomplete did I not include a page or so on human foods, for after the pupils have mastered the principles necessary to enable them to use the feed tables, we may let the girls figure on how to feed a family while the boys figure on how to feed the farm animals. How to feed the family I must leave for the books on domestic science. There is one subject, however, which belongs to agriculture, and that is, how to produce clean milk. It takes three or four times as much feed to make a pound of nourishment for a human, if the feed be fed for beef, as it does if the feed be fed for milk. Milk is everywhere the most economical food in America to-day. But we are in a peculiar transition period. The public is demanding cleaner milk and the farmers have not learned how to produce clean milk economically. Our schools have failed entirely to turn out pupils who help the farmers to produce clean milk economically.

FIG. 60.—A cream separator.

Milking machines (Fig. 59) are being improved and, for men

who can handle machinery to advantage, they may assist us in getting cleaner milk. The *clarifier* is a machine for taking out the filth from the milk. The *separator* (Fig. 60) takes out much of the filth at the same time it is separating the fat from the water. But the way the cows are fed has much to do with the production of clean milk. Most of the filth comes from the dust of the barn. If, just before milking, cows are fed ensilage, turnips, or grass containing garlic, the milk is very apt to taste of the ensilage, turnips or garlic. No milk is cleaner and no cows are healthier than those kept out and milked while out on pasture (Fig. 61).

HORSE FEEDING

Horse Feeding on Scientific Basis.—Horse feeding has had more careful, accurate study than has the feeding of any other animal, not excepting man. Tables have been made for, and rations tried on, express horses, cavalry horses, farm horses, and horses of all kinds at the different experiment stations, and from all of these we are led to believe that each 1000 pounds of a horse at heavy work needs 26 pounds of digestible dry matter, from which come 2 pounds of protein and 16 pounds of carbohydrates, each twenty-four hours. This gives a ratio of 1 : 8 instead of the old one of 1 : 6, though there are many scientific feeders who prefer the old narrow ration over the wide one. A standard might be made as follows: This is the ration fed the work horses at the Iowa station. Horses weighing 1200 pounds get 10 pounds of grain (oats, corn and bran, 3 : 2 : 1) and 12 pounds of hay each, per day. Horses weighing 1500 get 15 pounds of hay and 15 pounds of the same grain mixture. The New Hampshire station found the following fairly satisfactory: Timothy hay, 10 pounds; corn, 8 pounds; and bran, 7 pounds for each 1200 pounds of horse. Correspondence shows that a favorite ration for truck horses in our cities consists of 15 to 20 pounds of corn and oats, equal parts of each, and about 15 pounds of mixed hay each day for horses weighing 1500 pounds. When we figure these out by the tables for balancing rations, we find that the proportions approach the standards, but the total amount fed is somewhat below the standards.

Some General Principles.—The condition of both the animal and the feed, as well as the time of year and the work being

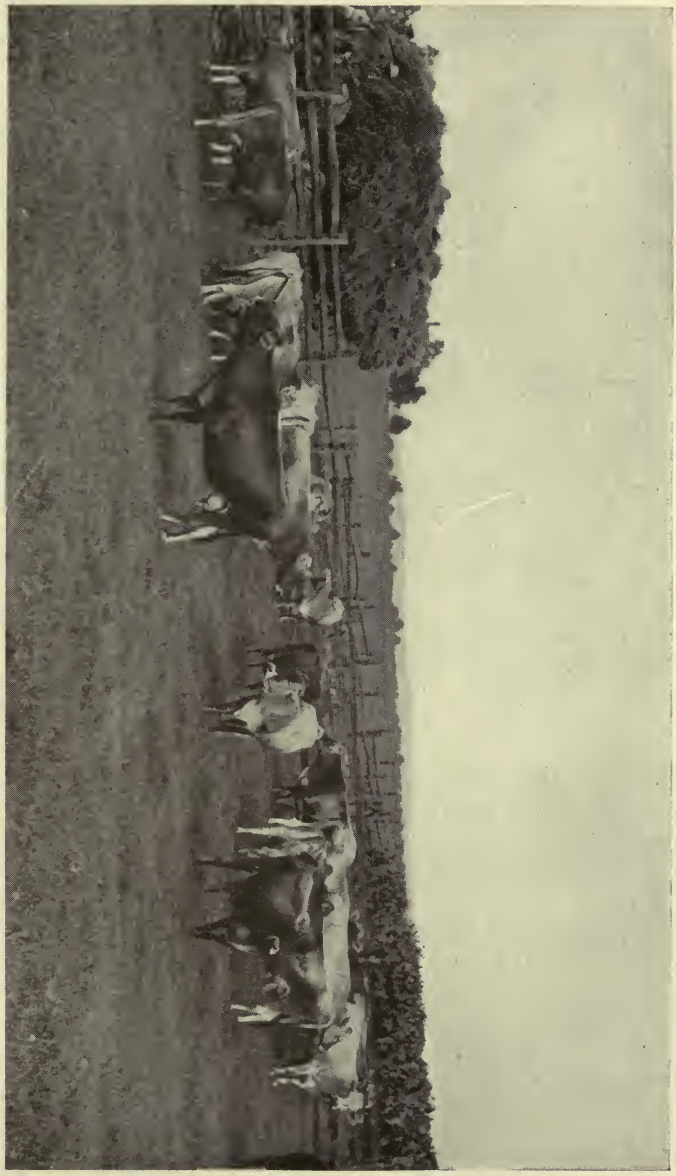


FIG. 61.—The cleanest milk comes from cows in pasture.

done, affect the amount of feed needed. Timothy hay is a general favorite among feeds for horses. It can be grown almost anywhere, is relished by horses and is comparatively free from dust. Timothy is more digestible if cut early. Oats are favored because they seem to agree with horses and give life and spirit; however, the experiments tried by feeding oats and then corn, changing about with the members of a team doing the same work, show that a horse when fed corn does as well as when fed oats.

Horses, like other farm animals, should have access to salt at all times, but if they get it only at irregular intervals they are apt to eat too much at one time. Perhaps more horses are injured by being fed too much than by being fed too little. It is not kindness to feed an animal merely because it will eat when tempted. It is not kindness to feed a horse just before he is put to hard work. Some of the leading expressmen have found it a good practice to feed the horse about one-quarter of his daily ration in the morning, one-quarter at noon and the other half at night. The horse has a small stomach in proportion to his size. Some of the food is forced through before it is thoroughly mixed with the digestive juices, hence it is a good plan to let the horse eat hay for a time after he comes in at night and then receive his grain later. This is especially true if the horse is tired or nervous. There is a difference of opinion as to when is the best time to water a horse; some prefer before feeding and others after. It would seem that it depends somewhat upon the horse.

Colic and Feeding.—"The danger of colic," says Gay in "Productive Horse Husbandry," "from putting a horse to work immediately after eating is unquestionable, as most cases of indigestion in working horses occur between one and four o'clock in the afternoon. In view of these facts, there is good reason to conclude that noontime spent in rest after moderate drink, and the amount of the noon feed added to the night allowance, would be more beneficial to a horse if it is impossible to allow him proper time and place to feed."

*Average Digestibility of Feeds and Their Fertility.**

Name of feed	Dry matter in 100 lbs.	Digestible parts in 100 lbs.		Fertility in 1000 lbs.		
		Protein	Carbohydrates (+fat ×2.25)	Nitrogen (N)	Phosphoric acid (P_2O_5)	Potash (K_2O)
Alfalfa, green	28.2	3.6	13.0	7.7	1.3	5.6
Alfalfa, hay	93.6	11.7	43.1	26.1	6.1	17.9
Alsike (in bloom), green	25.2	2.6	12.5	6.2	1.1	2.0
Beets, sugar	13.5	1.3	10.0	2.9	0.8	3.7
Brewers' grains (dried)	91.3	20.0	45.7	40.0	16.1	2.0
Canada pea meal	89.5	16.8	53.3	32.3	8.2	9.9
Cotton seed meal	93.0	37.6	43.0	72.5	30.4	15.8
Corn ensilage	26.4	1.4	15.7	4.3	1.1	3.7
Corn fodder, green	20.7	1.0	12.8	2.9	1.1	3.9
Cornmeal (all)	85.0	6.7	72.2	14.7	6.3	4.7
Corn stalks with ears	57.8	2.5	37.3	7.2	5.4	8.9
Corn stalks without ears	59.5	1.4	32.7	6.1	3.8	10.9
Corn and cob meal	84.9	4.4	66.5	13.6	5.7	4.7
Cow peas, green	16.4	1.8	9.1	3.8	1.3	4.6
Crimson clover, hay	90.4	10.5	37.6	24.3	4.0	13.1
Dried beet pulp	91.6	4.1	65.1	12.9	2.2	3.1
Gluten meal	90.5	29.7	56.2	54.8	3.3	0.5
Kentucky blue grass, hay	86.0	4.4	41.8	12.5	4.0	15.7
Linseed meal (old process)	90.2	30.2	47.5	54.2	16.6	13.7
Malt sprouts	90.5	20.3	49.1	42.1	17.4	19.9
Mangels	9.1	1.0	5.9	2.2	0.9	3.8
Oats	89.6	10.7	58.7	18.2	7.8	4.8
Oat forage, in bloom, green	25.0	1.1	13.5	2.6	1.3	3.8
Oat straw	90.8	1.3	41.3	5.8	3.0	17.7
Peas and oats, green	20.3	1.8	11.1	3.8	1.5	5.0
Red clover, green	29.2	2.9	16.4	7.0	1.5	4.8
Red clover, hay	84.7	7.1	41.8	19.7	5.5	18.7
Red top, hay	91.1	4.8	49.1	12.6	3.6	10.2
Ruta-bagas	11.4	1.0	8.5	1.9	1.2	4.9
Rye	91.3	9.5	72.1	18.1	8.6	5.8
Timothy, green	38.4	1.5	21.2	5.0	2.6	7.6
Timothy, hay	86.8	2.8	45.3	9.4	3.3	14.2
Wheat	89.5	8.8	70.8	19.0	5.5	8.7
Wheat bran (winter)	88.5	12.1	43.4	25.1	26.9	15.2
Wheat middlings	88.8	13.0	55.8	27.0	26.3	15.3

In quarts the dry feeds to make a pound would be: gluten meal 0.8, linseed meal 0.9, cottonseed meal, pea meal, cornmeal each 0.7, wheat 0.5, rye 0.6, oats 1, wheat middlings 1.3, bran 2, malt sprouts 1.7, brewers' grains 1.7.

* Chiefly adapted from W. A. Henry's "Feeds and Feeding."

Relative Values of Different Human Foods

Food	Protein, per cent	Fats, per cent	Carbohydrates, per cent	Ash, per cent	Magnesium, per cent in ash	Calcium
Apples	.4	.5	14.2	0.27	8.7	4.0
Asparagus	1.8	.2	3.3	6.4	6.3	15.9
Bananas	1.3	.6	22.0	...	8.8	12.5
Barley	8.5	1.1	77.8	2.5	9.6	3.5
Buckwheat	6.4	1.2	77.9	....	10.3	6.6
Cauliflower	1.8	.5	4.7	8.8	Trace	21.7
Cherries	1.0	.8	16.7	0.4	5.5	7.5
Cocoa	21.6	28.9	37.7	4.9	15.9	2.8
Cornmeal	9.2	1.9	75.4	....	14.9	6.3
Cow's milk*	3.3	4.0	5.0	....	.02	.16
Cucumbers	.8	.2	3.1	4.8	3.0	6.9
Grapes	1.3	1.6	19.2	2.25	8.8	36.9
Kohlrabi	...	...	....	8.9	2.3	10.2
Lemon juice	1.0	.7	8.5	0.2	3.3	7.9
Oatmeal	16.1	7.2	67.5	2.3	7.0	3.0
Peas	7.0	.5	16.9	2.6	8.1	5.1
Plums	1.0	...	20.1	0.31	4.7	4.9
Potatoes	2.2	.1	18.4	5.0	2.5	0.8
Radish	1.3	.1	5.8	6.4	3.5	8.8
Rice	8.0	3.0	79.0	0.67	13.4	0.8
Rye flour	6.8	.9	78.7	1.97	7.9	1.02
Spinach	2.1	.3	3.2	2.03	5.3	13.1
Tomatoes	.9	.4	3.9	....	...	...
Wheat flour	13.8	1.9	71.9	2.3	10.9	2.2
White cabbage	1.6	.3	5.6	11.6	3.7	12.6

* Whole milk.

A very interesting problem in human foods is being solved by the National Canning Club Girls. That is the problem of succulent calcium food for the winter months. They have as a motto, "A can of fruit, a can of greens, and a can of vegetables or its equivalent for every family, every day of the year." The above table offers some interesting figures of foods that may be canned or used green and that have an excess of calcium to balance the excess of magnesium which we are getting in our almost exclusive diet of seeds of the cereals.

Feeding Standards.—Pounds per Day per 1000 Pounds Live Weight

Animal	Total dry matter	Protein	Carbo-hydrates (+fat×2.25)	Total nutrients	Nutritive ratio
Horse, at light work	20.0	1.5	10.4	10.00	1:7.0
Horse, at medium work	24.0	2.0	12.3	12.80	1:6.2
Horse, at hard work	26.0	2.5	15.1	15.50	1:6.0
Cattle, fattening, first period	30.0	2.5	16.1	15.60	1:6.5
Cattle, fattening, second period	30.0	3.0	16.0	17.00	1:5.4
Cattle, fattening, third period	26.0	2.7	16.5	17.20	1:6.2
Milk cows, 11 lbs. milk daily	25.0	1.6	10.7	10.20	1:6.7
Milk cows, 22 lbs. milk daily	29.0	2.5	14.1	14.40	1:5.7
Sheep, fine wool	23.0	1.5	12.7	10.50	1:8.5
Sheep, fattening, first period	30.0	3.0	16.1	16.50	1:5.4
Sheep, fattening, second period	28.0	3.5	15.8	16.90	1:4.5
Swine, fattening, first period	36.0	4.5	26.5	31.20	1:5.9
Swine, fattening, second period	32.0	4.0	25.1	29.20	1:6.3
Swine, fattening, third period	25.0	2.7	19.9	22.00	1:7.0

QUESTIONS AND STUDIES

What have you learned about:

1. Mathematics and the feeding tables?
2. The importance of and the time of year to study feeds and feeding?
3. How to feed chickens? Dairy cows? Horses?
4. Balance a daily ration for a dairy cow giving 30 pounds of milk and weighing 1000 pounds, the standard being 29 pounds of dry matter, 2.5 pounds of protein, and 14 pounds of carbohydrates. Use 30 pounds of ensilage, 12 pounds of alfalfa hay and whatever else you think best.
5. Balance a ration for a 1000-pound horse at ordinary work, the standard being 24–2–12.3. Feed 10 pounds of alfalfa hay, 10 pounds of ensilage and whatever you think best.

What can you learn about:

6. Successful poultrymen in your home neighborhood and what they are feeding?
7. What successful dairymen are feeding?
8. What draymen feed their horses? What farmers feed?
9. What is the therm standard, and how and where it is used?

References.—Farmers' Bulletin (U. S. Department of Agriculture) No. 170, Principles of Horse Feeding; No. 22, The Feeding of Farm Animals; No. 186, Rations for Laying Hens; No. 202, Home-grown Protein for Dairy Cows; each of the following has something on feeds: Nos. 222, 225, 251, 262, 267, 305, 320, 329, 346; human foods are given in Nos. 74, 85, 93, 121, 128, 142, 182, 249, 298, and 281. Among the good books are Henry's Feeds and Feeding; Smith's Profitable Stock Feeding; Jordan's Feeding of Animals; Vol. III, Bailey's Cyclopedia of Agriculture; Plum's Beginnings in Animal Husbandry; Harper's Animal Husbandry for Schools; Burkett's Farm Stock; Day's Productive Swine Husbandry; Gay's Productive Horse Husbandry; Coffey's Productive Sheep Husbandry; Woll's Productive Feeding of Farm Animals.

Better farming, better business, better living.—ROOSEVELT.

We are dealing with a new subject. Six years ago, only three colleges taught anything that might be called Farm Management. Only two institutions were doing investigation work. . . . We face two serious problems. . . . City business men are among the first to see the importance of farm management. . . . These men with their "folly-farms" call for much help. These places have the same relationship to farm management that a golf course has to a hay field. I am convinced that it is harder for a rich city man to add to his wealth by farming than it is for "a camel to go through a needle's eye."

A more serious menace to our work is that all of our energies will be absorbed in teaching and in extension work. Investigation must precede any teaching or extension work that is worth while.—WARREN in President's Address (1913), American Farm Management Association.

The production of better crops and animals constitutes one phase of successful agriculture. It is the phase upon which most emphasis has been laid. . . . But higher crop and animal production does not represent all there is to good farming. An article which has been produced at too great a cost or marketed unwisely may bring no financial gain.—CARD in "Farm Management."

Farm management treats of the business of farming from the following standpoints:

1. Relative desirability of farming and other lines of business.
2. Selection of the farm.
3. Organization and equipment of the farm.
4. Farm operation.—SPILLMAN in "What is Farm Management."

CHAPTER VI

FARM ACCOUNTS AND FARM MANAGEMENT

Agriculture Follows Nature Study.—Agriculture is for the older pupils what nature study is for the younger ones. Among the "don'ts" for the teacher of agriculture is the one which says: Don't try to teach all of the pupils agriculture. Leave something that is new and fresh for the older pupils. Leading thinkers seem to agree that agriculture should not be given before the seventh and eighth grades. This is certainly true of the work outlined in this chapter. If we were sure that the children would go to high school, we would advocate leaving the farm bookkeeping until the high school is reached. The agricultural economics is given to suggest lines of reading for the boy who has left school or who is in the high school. Some of our present work in arithmetic can be abridged and the farm bookkeeping given to advantage.

Not Enough Bookkeeping on the Farm.—Children cannot, as a general thing, learn bookkeeping from imitation on the farm. Very few farmers keep a good set of books. But with the passing of our cheap land, better business management must come or the farmer go down in the struggle. The average farmer does not like to keep books, his hands are hard and stiff, he has not enough of the bookkeeping to do to make it interesting, and he often lacks a convenient place to keep his books. He has never done enough bookkeeping to give him that certainty or accuracy which makes work attractive. There are a number of reasons why we should adopt the French system and have the women keep the books. Women are naturally careful, economical and conservative. Women often have the time and the skill that enable them to keep a beautiful set of books. In case of the sudden death of the husband, a well-kept set of books is often the best of insurance policies, insuring against lawyers, administrators, and uncertainty as to what to do with the business. We do not argue for an extra burden to be put upon the overworked, tired mother. She has enough to do. Only where the woman enjoys the work, has the time, strength and experience

which will enable her to get pleasure from doing it easily and well, do we advise that the woman be the bookkeeper.

The Inventory.—A few hours in the winter, spent in invoicing the place, its stock and equipment, should be among the happiest hours that a farmer and his wife have together. Much joy comes to those who discover with mathematical certainty that they have accumulated a few hundred dollars, and the very certainty gives one inspiration to take hold for another year with renewed enthusiasm. Besides enabling a farmer to know his business with mathematical accuracy a well-kept set of books may enable him to avoid many disputes and occasionally a law suit. Accounts with merchants, money paid out, affairs with hired help or neighbors, if put down at the time in black and white, are not apt to cause trouble later.

Characteristics of a Good Set of Books.—A good set of books for the farm must be as simple as is consistent with guarding against uncertainties and mistakes. They should show the gain or loss, where gain or loss occurred, and they should furnish a satisfactory history of the different transactions such that a court would place confidence in the records should they be needed in court. Simplicity makes a single-entry system seem best; ease of recording and being able at a glance to see the history of a transaction make some extended five- or seven-column journal system appear best. But if a man has skill as a bookkeeper, and if he or his good wife has time to do the posting, a set of double-entry books is the more satisfactory.

Teach Children to Make Inventories.—The first thing for a farmer to do, and the first thing in farm accounts for a teacher to train children to do, is to make a neat, careful, and clear inventory of everything having a money value on the farm, especially if it will enter into production for another year. A valuable exercise consists in going with the pupils, some recess or noon, to some unhoused machinery and estimating the yearly depreciation. Then some correlation problems may follow in arithmetic, on the cost of a building, the annual depreciation and interest on the building, what it would save, what would be gained, etc. There may be applications of cases in arithmetic with which the child should be familiar, as the fraction, the percentage, and the ratio of gain. Children should have a separate tablet or a booklet started on Farm Accounts and Problems.

Some families may be sensitive about having the school look into the housing of their farm machinery, though the machinery is all out-of-doors. But there are farmers who are willing to coöperate with the school, and the teacher may use one of these farms as a basis for her work in farm accounts.

The aim of this work with inventories is to get the child interested in things at home and to get him to form the habit of getting enjoyment from keeping a good set of books. The habit will deepen as the years go by. It is well for the teacher to encourage the older boys and girls to try bookkeeping for a home project. Urge the pupils or the parents to buy a reasonably good book with which to begin. If too costly it encourages extravagance; if too cheap it fails to call out sufficiently the desire to be neat, accurate and tidy. It is well to hold out the hope, and to help the boys to form the ideal, that some day they are to keep their books and do their business at as good a roll-topped desk as has the business man in town.

Inventory

Name of farm ....

Date		
	acres of land @	$
	head of horses @	
	head of cows @	
	head of other cattle @	
	head of hogs @	
	poultry @	
	sets harness @	
	vehicles @	
	farm machinery @	
	tons hay @	
	bushels corn @	
	bushels wheat @	
	bushels oats @	
	bushels potatoes @	
	bushels apples @	
	Other farm products	
	Household furniture	
	Total	

This inventory may be used, even in the lower grades, as an exercise in penmanship or English. The pupil may put in the estimated values of things at home and then copy and recopy

until he gets a page good enough for a booklet on Farm Accounts or a page good enough, as a specimen of penmanship, for a school exhibit.

*Twin Grove Stock Farm,**
Renwick, Iowa, January 1, 1910.

INVENTORY

7 horses	$1,215.00	
19 cattle	810.00	
12 hogs	380.00	
130 chickens	78.00	
Farm machinery	309.00	
Silo	275.00	
Harness and fly nets	48.00	
Hay and ensilage	280.00	
400 bushels corn @ 50c.	200.00	
300 bushels oats @ 45c.	135.00	
5 bushels seed corn @ $2.00	10.00	
2 straw stacks	15.00	
60 bushels potatoes @ 60c.	36.00	
Cash in State Bank of Renwick	252.56	
Cash on hand	6.50	
		$4,050.06
Bills and rent not paid	$318.00	
Notes not paid	556.62	
Balance on silo not paid	167.50	
		1,042.12
Balance Jan. 1, 1910		**$3,007.94**
Balance Jan. 1, 1909		2,391.88
Gain from Jan. 1, 1909, to Jan. 1, 1910		**$616.06**

* This is an accurate inventory of an Iowa 80-acre farm and it represents the actual gain for one year.

It pays to have a page or two of inventories of the different things given in detail. Some prefer to have a page for each of the important farm products, that is, where dairying is the specialty, one page is given to the dairy cattle alone. If the farm is a hog and grain farm, then one page is given to hogs and another to grain. On the next page is an extended detail inventory of the cattle on a farm.

This inventory of everything on which he wishes to learn whether he has a gain or a loss, is of first importance to a farmer. Second in importance is the Cash Account. If the farmer will get a good cloth-bound book of some 500 or more pages, a good plan will be to start the inventories just past the middle of the book as they will not be needed often but will be referred to each year for some years to come. If Inventories, etc., are to have the last half of the book, then Cash Account may have the first

Cattle on (name of farm)

	January 1				
	1910	1911	1912	1913	1914
Born					
Cow Daisy.....................1907	$85	....	....	....	....
Cow Rhoda.....................1905	70	....	....	....	....
Cow Bessie....................1903	85	....	....	....	....
Cow Topsey....................1905	90	....	....	....	....
Cow Mary Ann..................1906	80	....	....	....	....
Cow Sappho....................1904	95	....	....	....	....
Cow Lorna.....................1908	80	....	....	....	....
Cow Victoria..................1905	70	....	....	....	....
Cow Thistle...................1906	95	....	....	....	....
Cow Queen.....................1906	90	....	....	....	....
Cow Ruby......................1907	85	....	....	....	....
10—2 yr. old steers @ 40	400	....	....	....	....
3—2 yr. old heifers @ 30	90	....	....	....	....
10—1 yr. old cattle @ 25	250	....	....	....	....
5 calves @ 10.........................	50	....	....	....	....
1 bull Morlich........................	200	....	....	....	....
	$1,635	....	....	....	....

page after the index pages. Cash Account will be the longest and, unless one wishes the trouble of frequently carrying the footings forward, there should be some 250 pages left for Cash Account. The Cash Account may be a simple double account to show Cash Received and Cash Paid, as in the following:

Cash

Date, 1910	Items	Received	Date, 1910	Items	Paid
Jan. 1	Cash on hand....	$251.63	Jan. 3	Overshoes........	$1.50
Jan. 5	For hogs.........	56.00	Jan. 5	Coal.............	5.00
Jan. 10	For cream........	24.00	Jan. 10	Groceries........	4.58
Jan. 12	For eggs.........	12.00	Jan. 14	Farm repairs, nails, hinges, screws, etc.............	1.52

A more extended Cash Account which will enable a farmer to keep a complete account with each of the leading articles from which he gets cash, or for which he pays cash, is the following. I think this extended column journal form is much to be preferred, and the teacher should take all the time necessary to

get young people thoroughly familiar with it so that they can use it with ease, accuracy, and pleasure.

Cash Received

Date, 1912		Items	Dairy	Poultry	Hogs	Horses	Grain	Fruit	Total
Feb.	1	Brought forward.....	...	...	...	...	.....	...	$257.63
Feb.	2	Hogs sold to Buel....	...	...	$56	...	.....	...	....
Feb.	3	Cream check........	$24	...	...	...	.....	...	....
Feb.	10	Eggs sold to Wilders and chickens to Prebe	...	$12	...	...	.....	...	....
Feb.	15	2 calves sold to Lovains..............	20	...	...	...	.....	...	....
Feb.	20	Corn sold to Peterson	...	...	...	...	$18.60	...	....
Feb.	24	Hogs sold to Smith...	...	...	18	...	.....	...	....

A similar page should be kept for Cash Paid Out. One may keep the Cash Received on the left-hand page and the Cash Paid Out on the right-hand page. This enables one to compare items at a glance.

Another system of bookkeeping favored by many is to buy a loose leaf ledger, from which the pages as fast as filled may be removed and placed at the back for reference or on file elsewhere. Yet another form, which is very handy, consists of keeping loose sheets on file between index cards in a filing cabinet made especially for the cards. This is very handy for one who has a roll-top desk or regular filing boxes. Each person with whom the farmer has dealings, other than for Cash, should have a separate page or card. It is well to begin the Personal Account page just before the Inventory page and work toward the front of the book, that is, if Inventories begin on page 250, then use page 249 for the first Personal Account, page 248 for the next, etc. This leaves the pages between Cash and Personal Accounts blank until needed.

The Index is important. The name of each account should be written on that page of the Index containing the first letter of the account. To illustrate: The general Inventory should be placed under the letter I in the Index and the number of the page on which the Inventory occurs written after the word "Inventory." The Inventory on Cows should come under "C" and the name and page written. So the name of Cash, and each person with whom an account is kept, should be written under the

appropriate letter and the page number given. In addition to that one may open the book at "Inventory" and with a sharp knife cut off a little of the upper left-hand corner pages. This will make a natural opening ledge for the fingers at the Inventory pages. As the Cash pages are used a small triangle may be clipped from one corner of each successive page so a continuous ledge will open at once to the page being used.

*A Sample Heading for a Page of an Account Book Showing the Special Ruling Required for Entering Chores.**

1913	Horses		Cows		Poultry		Hogs	
	Hours	Minutes	Hours	Minutes	Hours	Minutes	Hours	Minutes
May 1..............	2	20	4	15	....	30	1	10
2..............	....	....	....	....	....	....	....	....
3..............	....	....	....	....	....	....	....	....
4..............	....	....	....	....	....	....	....	....
etc............	....	....	....	....	....	....	....	....

*If horses are used in the chore work, extra columns must be ruled under each heading to provide a place for the entry of hours and minutes of horse labor.

Farm Records.—The scientific farmer of to-morrow is going to keep a number of records. Probably some card system will be found most convenient and economical of space and time. There are to be special records for time, milk, eggs, breeding, fruit, etc.

The time record may be conveniently kept on a system of cards somewhat like the following taken from Card's "Farm Management":

Frank Anderson *Time Card* March, 1912

	1	2	3	4*	5	6	7	8	9	10	11*	12	13	14	15	16	17	18*	19	20	21
Dairy...........	1	¾	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Poultry.........	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Swine...........	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Teams..........	1	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Orchard.........	..	1¼	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Wheat field......	8	6	8	0	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Oat field.........	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Corn field.......	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Potatoes.........	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fencing.........	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Miscellaneous....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

*Sunday.

The following is taken from Farmers' Bulletin No. 572:

A Sample Work Record with Wheat.

1912	Operation	Man		Horse*	
		Hours	Minutes	Hours	Minutes
Aug. 2	Plowing oats stubble...........	8	30	17	......
	Rolling.........................	1	45	3	30

*Horse hours are expressed in terms of one horse for one hour. Hours of horse labor should not be charged against the horse account.

Milk Records.—Milk records from each individual cow are very important. When there is a good one, the farmer needs to be a member of the cow-testing association. If the high school is really teaching agriculture and is being run for the people in the country, there should be a high school cow-testing association. Cow-testing associations are more important where the farmer sells butter fat than where he sells milk. Where common dairy herds have been tested, it is generally found that a number of cows are not paying for their feed. One man found that he was actually giving from five to nine dollars each for the fun of milking five cows a whole year. The record on page 143 is issued by *Hoard's Dairyman* and is one of the best for a weekly record of twenty cows.

Teach Girls Household Accounting.—The longing to go to town to live would be considerably abated in many instances if our girls were taught a system of scientific household accounting; that is, if our women were made conscious of the advantages of the farm by crediting the farm with what it furnishes for the family support. The farm should be credited with fruit, milk, eggs and vegetables that are used in the house, as well as those that are sold. The farm should be credited with rent and fuel. The United States Government has found that the budget of the average family, living on an income of less than $2000, divides the income as follows: Food 25 per cent, rent 20 per cent, clothing 15 per cent, incidentals, medicine, etc., 15 per cent, education, church, travel, books, etc., 25 per cent. It is a valuable exercise to have girls in school, figure out what their living in town would cost if they were to live as they do on the farm. If a family is not living within its income, the house mother

SEVEN DAY MILK RECORD FOR TWENTY COWS

________________________________FARM

Daily Milk Record for Week Ending____________________191__

Name of Cow________________________ ______________ Date of Calving______________

DATE	M—Morning E—Evening	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.	NAME OR NUMBER LBS.
	M																				
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should place the family budget beside that of her 11,000 sisters, as found by the United States Government and given in the table (p. 143), and from the comparison find in what division the account overruns. In all probability where it overruns the average is the place to begin to cut down expesses.

Teach Boys Farm Management.—The new agriculture makes of the farm a modern business enterprise and of the farmer a modern business manager (Figs. 62, 63) or "entrepreneur," as the French would say. This demands a careful study of the number of acres which a man can handle to advantage. It now seems as though the farmers who are making most money, farm a little over two hundred acres each. This contradicts a very prevalent opinion that our farms are too large and are to be broken up and more intensive farming adopted. It would seem that most people fail to distinguish between the fruit grower, the truck gardener and the farmer. Then again, just as there is a certain proportion into which each of the household activities fall, there is a certain proportion that a farmer must find of capital invested in land, stock, machinery, etc. For example, a silo is a very valuable addition to a farm, but it has been found that the average man with less than ten cows cannot make a silo pay for filling and interest on the investment. So there are certain machines which one farmer cannot afford to own but which should be owned in coöperation with others. The same is true of some breeding animals.

From "Productive Orcharding" (Sears).

Fig. 62.—A magazine advertisement that is sure to attract attention.

Teach Farm Management through Arithmetic.—Farm arithmetic, such as found in the second half of Miss Jessie Field's book, "The Corn Lady," may be taught either as supplementary problems to the regular cases in arithmetic or as exercises in agriculture. The following problems taken from that book may be given toward spring as interest in the land begins to revive.

1. Suppose a 40-acre field, planted to corn 5 years in succession, produces 60 bushels per acre the first year, 55 the second, 43 the third, 33 the fourth, and 30 the fifth, what will be the value of the corn grown in the 5 years at 40 cents per bushel? *

2. Suppose, instead of growing corn continuously, the farmer had practised the following rotation: First year, 40 acres corn, 60 bushels per acre at 40 cents per bushel; second year, 40 acres oats, 60 bushels per acre at 30 cents per bushel; third year, 40 acres clover, 3 tons per acre at $8 per ton; fourth

From "Productive Orcharding" (Sears).

FIG. 63.—A load of apples on the way to market. This is a good type of wagon for hauling barrels. It is low, making it easy to load, and will carry twenty-five barrels easily.

year, 40 acres timothy, 2 tons per acre at $9 per ton; fifth year, 40 acres corn, 70 bushels per acre at 40 cents per bushel. What would have been the value of the five-years' crops? Which of the two five-years' crops would have been the more valuable? Which would leave the field in better fertility for the future? The teacher may multiply this problem many times by taking the average yields of her locality and using a three-, four-, and five-year rotation. There are hundreds of other problems in farm arithmetic, two, three or five of which may be given to supplement every case in the arithmetics and which, as Professor Bailey says, would revolutionize farm life.

* Other valuable supplementary problems may be found in the Noble and Stevens, also Stevens, Butler and Stevens arithmetics, or in the Farm Arithmetic by Burkett and Swartzel.

10

Then there is another set of problems that make interesting and valuable winter work. Every farmer should have a plat or map of his garden and orchard. The names of the trees and the rotation of the garden crops soon slip from memory. A plat of the orchard with the name of each variety of tree or fruit should be a part of the permanent record of the farm. This plat may be drawn on the back pages of the ledger or on loose paper and pasted in the ledger. The plat of the garden for the coming year will make interesting work. How may we plant so as to keep the light-loving plants from being shaded, so as to allow us to use the ground to advantage for the early and then late crops on the same ground, etc.?

To be a better farmer than his father, a boy must become a close student of natural advantage in production as determined by location, climate, market, his natural likings, preparation, etc. The day has gone when the farm will supply all of the needs of a family and when we may expect the farmer to sell only what is left after supplying his family. The twentieth-century farm is run for a profit on some one product or group of products. The farmer of to-day is conscious of the futility of attempting to compete with other places and other climates in the production of certain commodities. It is a part of his business management to find what can be produced in his locality to greatest economic advantage and when he has found it, and how much he can produce with a maximum profit, to centre his efforts on that. While there are many things to do on a farm there is always some one thing that must be done on time and done well. Other things are incidentals.

A boy, before he becomes a farmer, should become familiar with the law of diminishing returns and the modern economic theory of value. These are part of his racial inheritance. A boy should be made conscious of the economic law which says "the normal value is determined by the cost of producing the last considerable portion, which portion is produced at the greatest disadvantage and which portion is necessary to supply the demand." This means that some people are always selling at cost of production. It is for a boy to determine whether he is to be one of that class.

Then, again, the modern farmer should be familiar with the laws determining the distribution of wealth. He should be

sufficiently conversant with public affairs to know, with reasons, whether the middlemen are getting more than their share of what he produces and others consume. He should know whether he is getting his money's worth for what he pays in taxes. Rural governments are to-day dead, inert things. They must be quickened into life. The mental attitude of the farmer must be changed. We must pass from the belief in a jack-of-all-trades to the belief in specialists in government as well as in other things.

What a family gets from a farm is not all measured by money. The landscape is part of the income, the uses of schools, roads, churches, doctors, lecture courses, and other things go to make what the economists call the social income.

Enough has been said on farm accounts and agricultural economics to enable teachers to know that there is much to teach. In the grades only a few of the important things can be hinted at, but a teacher may suggest to the boys and the girls that the subject is one well worth their while taking for a whole year as one of four studies in an agricultural college or high school. In the leading high schools, where agriculture is given as one of four studies for each year, the course offered follows closely the work recommended in this book. The first year is given to the study of plants, the second year to the study of animals, the third to growing and feeding of plants, and the fourth to the study of farm business management and community organization.

Teachers should impress upon their pupils the fact that where statistics have been taken it has been found that boys who go to farming, after completing a high school course, make more than the interest on $6000 over boys who left school before they finished the high school. Those who go to college make the interest on $10,000 more than those who do not go to college. Put in another way, estimating that the boy will be producing for forty years, we find that he makes $16.28 for every day he spends in high school. This, too, is a fact which the boy has a right to know before he decides not to go to high school and college. And his father needs to know that it is better, from a money standpoint alone, to give his boy a high school education than $6,000 in money. But the money value is the smallest part. The real value comes from the pleasure there is in being more fully conscious of what you are doing and of the beauty in the world around you.

Farm Management.—Farm management is a comparatively new science. It aims to tell what is the best organization for land, labor and capital on the farm. Men differ wonderfully in their ability to handle land, labor and capital so as to make a profit. The man who raises the largest crops does not necessarily make the most profit. The man with the best looking farm is not always the man who is paying off the mortgage. Recently the United States Department of Agriculture has had men making very careful studies in all parts of the United States, in order to learn why some men make money on the farm and others do not. The following is a summary of the study of some six hundred farms in a dairy section. The farms much larger than one hundred acres are not considered. Farms smaller than eighty acres were not considered in this study. Farms not run by their owners were also left out and then we have left some two hundred farms from which we take the twenty that average the lowest profit which in farm management is called *labor income.* We take the twenty farms that were paying the highest labor income; these are averaged in the studies which follow:

Average of 20 Poorest Farms

From 80 to 120 Acres. Average Area 99 Acres

Receipts		Expenses	
Potatoes	$103	Labor	$385
Wheat	113	Feed	146
Hay	244	Seeds	36
Other crops	56	Fertilizers	102
Cattle	225	Livestock	172
Hogs	18	Machinery and repairs	97
Poultry	84	Taxes and insurance	87
Eggs	102	Miscellaneous	88
Milk	475	Inventory loss	93
Miscellaneous	170		
Inventory gain	93		
Total	$1,683	Total	$1,206

Capital		Summary	
Land and buildings	$8,194	Receipts	$1,683
Machinery and tools	459	Expenses	1,206
Livestock	1,055	Farm income	477
Supplies	217	Int. on capital at 5 per cent.	501
Working capital (cash)	105	Labor income	–24
Total	$10,030		

The average crop area was 56 acres; number of cows milking, 9.4 for 12 months in the year; per cent of income from crops, 34; crop area per horse, 16.3 acres; number of horses, 3.7; receipts per cow, $48; working capital other than land and buildings, $1835; crop index compared with 100 per cent, 84 per cent.

Now compare these unsuccessful farmers who actually gave $24 for the fun of farming, with twenty farmers who are making an income of over $2000 per year and getting house rent, milk, eggs, garden truck, fruit and much of their fuel in the bargain.

Average of 20 Best Farms

From 80 to 120 Acres. Average Area 101 Acres

Receipts		Expenses	
Potatoes	$400	Labor	$602
Wheat	245	Feed	408
Hay	335	Seeds	58
Other crops	89	Fertilizers	164
Cattle	360	Livestock	308
Hogs	105	Machinery and repairs	311
Poultry	92	Taxes and insurance	101
Eggs	159	Miscellaneous	155
Milk	2,238	Inventory loss	18
Miscellaneous	130		
Inventory gain	702		
Total	$4,855	Total	$2,125

Capital		Summary	
Land and buildings	$9,480	Receipts	$4,855
Machinery and tools	974	Expenses	2,125
Livestock	2,941	Farm income	2,730
Supplies	399	Int. on capital at 5 per cent	697
Working capital (cash)	153	Labor income	2,033
Total	$13,947		

The average crop area was 63 acres; number of cows milking, 20; number of horses, 5; receipts per cow, $106.50; crop acres per horse, 12.6; crop index, 117; working capital, $4468.

How to Teach Farm Management.—I suspect teachers will think farm management harder to teach without a book than almost any other subject. Farm management appears abstract and intangible, but really it is an easy subject to teach without a book. Of course the teacher should have a book and

know what she is aiming to teach. The inventory is a good subject with which to begin the subject of farm management.

Mapping the Farm.—One of the first things a farmer must know if he is to get a good profit for his labor is whether his fields are so shaped and his rotations so scheduled that his fields are to be handled to advantage (Figs. 64 and 65). Even before that he must decide whether he is to be a grain or a dairy farmer,

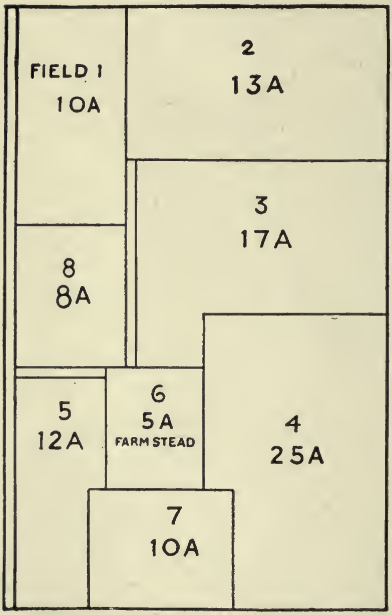


Fig. 64.—An Eastern farm as it was when sold.

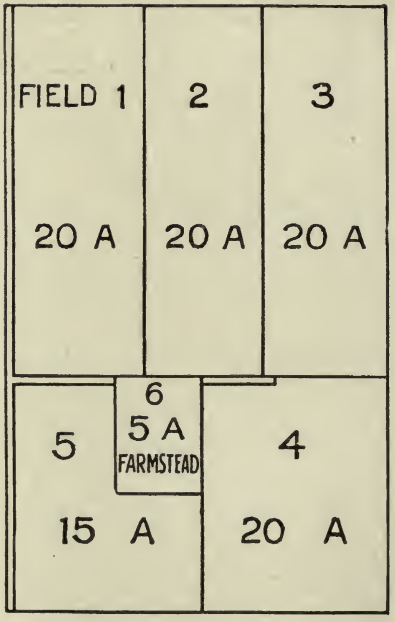


Fig. 65.—The same farm as given in Fig. 64. One hundred acres. The remapping saves about 300 rods of fence and an average of about 30 rods of travel to fields.

whether he is to follow the soiling system or pasture for part of the year. These questions the schools will find have been settled. Then the school is ready to have pupils bring in maps of the home farm. Maps of eastern farms will be found to contain fields that are entirely too small. A rectangular piece of ground can be plowed and cultivated to better advantage than can a square field. The larger the fields, the more economically can they be tilled. If the fields are not of about uniform size, they will not

enable the farmer to follow a regular system of rotations. If there are small patches on hillsides, especially southern, they should be seeded to alfalfa and left as long as the stand is good, then plowed and cultivated for as short a time as necessary to get rid of the weeds and seeded to alfalfa again. If there are low, irregularly shaped pieces, they may be seeded to timothy and left for hay or pasture. Comparatively level, long, uniform-

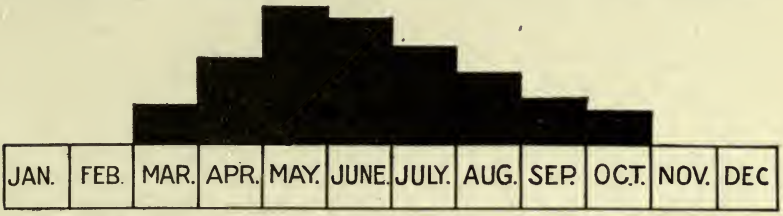


FIG. 66.—Labor schedule for young chickens. (After Warren.)

sized fields are the ones to fall into the regular rotations of corn, wheat or oats, clover, timothy and back to corn again. But unless the fields or a combination of certain fields are equal in size, the farmer will have too much of one crop one year and not enough another.

Labor Schedules.—A good labor income from farming, like a profit from banking or manufacturing, requires that the plant run at a profit for every day throughout the year. A good exer-

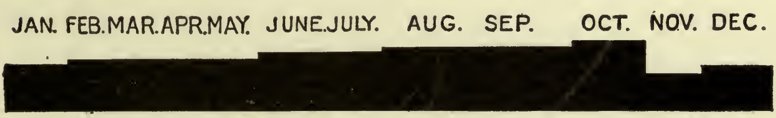


FIG. 67.—Labor required for care of laying hens. (After Warren.)

cise in farm management consists in planning something for a regular amount of labor to do at a profit every month in the year. The farmer who has more than he can do at one time of year and not enough to do at another is not a good manager. The above from Warren's "Farm Management" (Figs. 66, 67) tell how labor is distributed throughout the year if we consider the poultry business only. Manifestly a man would be foolish to go into a system of farming where he raised many little chickens and had extra work during the months of June and July

unless he had a son or a daughter in school but who would be at home to help during the summer vacation.

Another blunder which some people make is to go into certain market garden crops and hope to carry them on with the chicken business. Asparagus and strawberries have to be harvested at a time when the amount of labor for the chickens is increasing each week. Chickens and strawberries require the most labor, for each, at the same time during the month of June. Discussions along these lines are valuable and may save many farms from becoming burdens to their owners.

Have Leading Farmers Help.—As was suggested in the chapter on plant breeding, a very good exercise consists of having some farmer who is known to have made money, tell the pupils what he believes to be the most profitable system of farming, what rotations he recommends, how he arranges his labor schedules, etc. It may be that the farmer can talk better on his own farm where he is able to point to his successes and failures. If so, let the teacher go with a group of the pupils to visit the farmer. Have it arranged that certain pupils are to ask certain questions and " keep the ball rolling," as we say.

Teach Farm Score Card.—Certainly each teacher can teach the pupils to score one or two farms. This may save those who buy, or who must rent, many dollars in years to come. Few farmers know how to judge a farm critically. There may be a difference of opinion as to the relative value placed on the different points in the score card, but the becoming conscious of the different factors that go to make a farm a profitable farm is helpful to any one who is to farm for a living. Be sure to caution pupils against scoring highest the farm that is over-equipped. It may be beautiful, but no man should be asked to make interest on it, with man labor.

A Farm Score Card

	Perfect score				
I. *Location*—25					
1. Distance to markets	4	...	...	...	....
2. Roadways	4	...	...	...	....
3. Local markets	4	...	...	...	....
4. Shipping facilities	2	...	...	...	....
5. Labor supply of district	2	...	...	...	....
6. Neighbors as an economic factor	3	...	...	...	....
7. R. F. D., telephone, trolley, etc.	3	...	...	...	....
8. Churches, schools, grange, clubs, etc.	3	...	...	...	....
II. *Topography*—7					
9. As affecting ease of cultivation	2	...	...	...	....
10. As affecting number of days' work	1	...	...	...	....
11. As affecting loss of fertility	2	...	...	...	....
12. As affecting kinds of crops possible	2	...	...	...	....
III. *Drainage*—5					
13. Natural	3	...	...	...	....
14. Artificial	2	...	...	...	....
IV. *Water Supply*—5					
15. Running	3	...	...	...	....
16. Wells	2	...	...	...	....
V. *Size of Farm*—8					
17. As adapted to kind of farming intended	3	...	...	...	....
VI. *Condition*—4					
18. Freedom from stones, stumps, weeds, waste	4	...	...	...	....
VII. *Fertility*—15					
19. Natural	10	...	...	...	....
20. Condition	5	...	...	...	....
VIII. *Climate*—6					
21. As affecting animal and plant production	4	...	...	...	....
22. As affecting number of days' work	2	...	...	...	....
IX. *Healthfulness*—5					
23. As an economic factor	5	...	...	...	....
X. *Improvements, Equipment, etc.*—20					
24. Location of farmstead	3	...	...	...	....
25. House as adapted to needs of farmer	5	...	...	...	....
26. Other buildings as adapted to needs	5	...	...	...	....
27. Water equipment	2	...	...	...	....
28. Fences, kinds, condition, arrangement	2	...	...	...	....
29. Timber, orchards, vineyards, gardens, etc	2	...	...	...	....
30. Taxes, per cent on cash value	1	...	...	...	....
	100				

QUESTIONS AND STUDIES

What have you learned about:

1. Bookkeeping on the farm?
2. What books to keep on the farm?
3. What an inventory is? A cash book? An extended column journal?
4. How bookkeeping differs from agricultural economics?
5. How agricultural economics differs from farm management?

What can you learn about:

6. How the farms in your district compare with the 20 farms given?
7. What is being done in your district to improve farm management?
8. What a farm bureau is, and if you have one?
9. What the chances are for men who are good farm managers?
10. What is the money-making line in your neighborhood?

References.—Farmers' Bulletin No. 572, A System of Farm Cost Accounting; No. 511, Farm Bookkeeping; Bexell and Nichols, Principles of Bookkeeping and Farm Accounts; Warren, Farm Management; Card, Farm Management; Farmers' Bulletin No. 365, Farm Management in the Northern Potato-growing Sections; No. 472, Systems of Farming in Central New Jersey; No. 432, How a City Family Managed a Farm; No. 272, A Successful Hog and Seed-corn Farm; No. 437, A System of Tenant Farming and Its Results; Bulletin No. 259, Bureau of Plant Industry, What is Farm Management?

Courtesy Sharpless Separator Company.

FIG. 68.—A modern dairy barn. Cement and glass sides and asbestos shingles. Feed is kept in silos and in the old barn.

Hercules threw Antæus to the earth again and again but, strengthened by his mother as he touched her, Antæus rose stronger and able to fight more vigorously than before.—Greek Story of Antæus.

Complete a square on lines drawn from Chicago southward to the Gulf and westward across Kansas and there will be enclosed an area greater than the cultivated fields of China, Korea, and Japan and from which five times our present population are fed. . . . The Mongolian races, with a population now approaching 500 millions, occupy an area little more than half of the United States, tilling less than 800,000 square miles of land, and much of this during twenty, thirty, or perhaps forty centuries. . . . The people of the United States and Europe are pouring into the sea, lakes or rivers, and into the underground waters from 5,794,300 to 12,000,000 pounds of nitrogen; 1,881,900 to 4,151,000 pounds of potassium, and 777,200 to 3,057,000 pounds of phosphorus per million of adult population annually, and this waste we esteem one of the great achievements of our civilization.—King in "Farmers of Forty Centuries."

There are only four essential things to consider in converting all the thin fields between the Mississippi River and the Atlantic seaboard into productive land:

1. Drainage.
2. Destruction of acids.
3. Organic matter.
4. Available plant food.—Agee in "Essentials of Soil Fertility."

CHAPTER VII

THE SOIL

The Study of the Soil Interesting.—To those who have given it little attention, nothing can be more uninteresting than the study of the soil. To most school teachers the soil is dirt and nothing more; but to primitive woman, who first tilled the soil, it was a realm inhabited by spirits with power of life and death over her and hers. And so, to the normal healthy woman who is not perverted by the commercial craze for conspicuous display of wealth, the soil is a loved thing and, if she lets her natural instinct lead, as spring returns she finds herself, like her sister among the primitive people, longing to dig and plant in mother earth. To the thinking farmer the soil becomes a peculiar object of affection as it responds to his care and culture. Even poet minds, which so often see deeper and farther than common minds, have found the soil not uninteresting.

What Ruskin Saw in a Handful of Soil.—"Exclusive of animal decay, we can hardly arrive at a more absolute type of impurity than the mud or slime of a damp, overtrodden path in the outskirts of a manufacturing town. I do not say mud of the road, because that is mixed with animal refuse, but take merely an ounce or two of the blackest slime of a beaten footpath on a rainy day, near a large manufacturing town.

"The slime we shall find in most cases composed of clay (or brick dust, which is burnt clay) mixed with soot, a little sand and water. All these elements are at hopeless war with each other and destroy reciprocally each other's nature and power, competing and fighting for place at every tread of the foot; sand squeezing out clay, and clay squeezing out water, and soot meddling everywhere and defiling the whole. Let us suppose that this ounce of mud is left in perfect rest, and that the elements gather together, like to like, so that their atoms may get into closest relation possible.

"Let the clay begin; ridding itself of all foreign substances, it gradually becomes a white earth, always very beautiful, and fit, with help of congealing fire, to be made into finest porcelain,

and painted on, and be kept in king's palaces. But such artificial consistence is not its best. Leave it still quiet to follow its own instinct of unity and it becomes not only white, but clear; not only clear, but hard; not only clear and hard, but so set that it can deal with light in a wonderful way, and gather out of it the loveliest blue rays only, refusing the rest. We call it then sapphire.

"Such being the consummation of the clay, we give similar permission of quiet to the sand. It also becomes first a white earth and then proceeds to grow clear and hard, and at last arranges itself in mysterious, infinitely fine parallel lines, which have the power of reflecting not merely the blue rays, but the blue, green, purple, and red rays in the greatest beauty in which they can be seen in any fired material whatsoever. We call it then an opal.

"In next order the soot is set to work; it cannot make itself white at first, but, instead of being discouraged, tries harder and harder and comes out clear at last, and the hardest thing in the world; and for the blackness that it had, obtains in exchange the power of reflecting all the rays of the sun at once in the vividest blaze that any solid thing can shoot. We call it then a diamond.

"Last of all the water purifies or unites itself, contented enough if it only reaches the form of a dew drop; but if we insist on its proceeding to a more perfect consistence, it crystallizes into the shape of a star. And for the ounce of slime . . . we have . . . a sapphire, an opal, and a diamond, set in the midst of a star of snow."

The Study of the Soil Interesting to the Chemist, the Biologist, and the Physicist.—Such is the poet's vision, but the scientist finds the soil no less interesting. Be he a physicist, he finds the soil a wonderful laboratory filled with elements of different kinds going through some physical action constantly. Think of the action going on within a single cobblestone made up of a number of minerals which expand and contract at different rates with the heating and cooling of the day and the night. This gradually crumbles the stone and brushes dust particles from the faces of the tiny elements, which give us the mineral plant food.

But the soil is not alone interesting for the man enamored

by physics; it has an equal interest for the chemist, because no sooner are those dust particles set free than they begin to form some new compound, and thus the soil becomes an ever-active chemical mixture, giving many different actions and reactions.

Not only for the physicist and the chemist has the soil interest, but the biologist finds the soil a wonderful field of life and death, of trouble and extinction. The soil is loaded with bacteria of many kinds, with earthworms carrying plant stems and leaves down into the soil to set up new physical, chemical, and biological activity; with ants and bugs, with gophers, moles and snakes all making openings which let in warmth, water and air which start up renewed activity. And what shall we say of the farmer who sits by his warm fire on a cold, rainy or freezing night conscious that nature is working for him to prepare plant food for the coming crops? Surely a little piece of God's green earth and man's cleared field should belong to every conscious soul.

The Formation of the Soil Taught First in Geography.—Though the formation of the soil belongs to physiography, or physical geography, yet the elementary treatment of the subject is given in nearly all introductory geographies, and the teacher should be prepared to tell something, and to tell especially of the formation of the soil of her own locality (Fig. 69).

The History of the Glaciated Soil.—A wonderful history is that which tells of the formation of the soil in any given locality. I do not know where it begins, but, with our present knowledge as recorded in the geologies, we cannot go back of the time when the substance of which the earth is made existed in the form of star-dust floating through space. This star-dust was drawn together by gravity and could assume but one form, the sphere, but owing to its rotation this sphere was slightly flattened at the poles. The friction caused by these particles coming together made them hot, so that all was probably a molten mass which gradually cooled and formed a crust on the outside. The sphere went on cooling until the inside became too small for the crust, just as the contents of a plum do as the moisture escapes; then the crust of the sphere had to fold and wrinkle just as the plum rind does. Gravity drew the water to the lower places, leaving the tops of the folds exposed. These enlarged until we have much of our land. Animals and plants began to build in

FIG. 69.—Where the soil is made. View on Manati-Ciales road, Porto Rico.

the water near the shores and give us our limestone, coal, etc., which crop out at many places. Then great fields of ice slid down over the northern states carrying much material from the roots of the old mountain chains just north of the United States; this material was spread over the limestone rock made by the animals and plants in the ocean water. Then the glaciers melted, and the wind, and water from the melting glaciers, and the rains redistributed the material which was again covered by glaciers, one, two, three, four, five times, and this material was each time redistributed.

Man works and sweats to get his plowing done with an iron plow, turning a furrow fourteen or sixteen inches wide and four to twelve inches deep. Too often he is unconscious of his rich inheritance from the Great Farmer who plowed the land with His great ice machine a thousand miles wide, turning a furrow hundreds of feet deep. And now every winter the Great Husbandman sends His icy needles into the ground two and three feet deep, to loosen the soil for water, air, and plant roots.

It is hardly necessary to call the teacher's attention to the fact that one reason why clay soils in the south are so hard is because the clay is never loosened by the action of frost.

The Soil Robber.—I am sorry that American industrial history does not enable me to say that the American farmer has appreciated his gift, and properly cared for and conserved God's greatest bequest to man. Population is increasing rapidly. A million and a quarter of human beings come to our country each year. If we wish to implant patriotism instead of "pat-riotism" we must see that these foreigners quickly learn our language and become comfortably adjusted to the soil. These foreigners are, in the main, hard-working and honest, and they will be easily led to read our agricultural papers, which will give them both a mastery of our language and an understanding of how to care for, cultivate and maintain the fertility of our soil. It is a shame to have to say it, but we are heirs of the "soil robbers." This robbery cannot go on forever. But there is no reason to become frightened if we teach our foreigners and rising generation how to conserve the soil fertility. There is room and capacity, on and in our soil, to feed the population of the globe and not tax it as much as the soil of Egypt or Belgium is taxed.

The Study of the Soil May Inculcate Love of Country.—One of the best ways to make a foreigner love a new country is to put him quickly into possession of the knowledge that makes him master over some of its resources. One of the easiest ways to fire the imagination and ambition of our young people is to make them conscious of the possibilities that lie buried in the soil. Says Professor Roberts, in Bailey's "Cyclopedia of Agriculture": "The average of 34 soils, analyzed by various American chemists, showed that the first eight inches of soil of an acre contained potential plant food as follows: Nitrogen 3217 pounds, phosphoric acid 3936 pounds, and potash 17,597 pounds, making a total of 24,750 pounds, or more than 12 tons. These figures make it evident that it is not fertility that is wanted, but productivity. Since even a moderate dressing of manures almost invariably increases productivity, it follows that tillage is deficient or that plant food in the soil is largely unavailable, that is, woefully lazy; or that the soil is not continuously moist enough for normal growth of plants, or that it is too moist, or that the climate is not well suited to the crops grown, or that the seeds lack potency."

The Scientific Study of the Soil a New Study.—The hope and imagination of every school child should be stimulated by the fact that no man yet knows the best way to grow any plant or animal. The science of the soil is just in its infancy, although much valuable work has been done.

Things to Teach.—There are a number of interesting things to teach children regarding the soil. One is that its blackness is largely due to decaying plant and animal matter and is an indication of fertility. Another is that plant roots need air and the soil breathes somewhat like an animal. As the wind rushes from a place it sucks the air of the soil out with it and, as the calm comes, the air rushes back into the small cavities of the soil again. Recent discoveries announced by the United States Department of Agriculture, though disputed by some, bid fair to reveal an explanation of many difficult problems in soil management. These discoveries are that each plant secretes a toxic, or poisonous substance, for plants of the same kind. These discoveries offer a partial explanation for the advantages derived from a systematic rotation of crops. They help us to understand why we may fertilize ever so much and not get much

larger crops. They explain why it seems best to change the strawberry bed every two or three years and the small fruits, like raspberries and blackberries, every ten years. Though we now learn that plants, like fish confined in a small body of water, poison their media, yet it must not be forgotten that there is much truth in the older explanation that any variety of plants will soon use much of the available food while another kind of plants, which use different relative proportions of food, may thrive in that same soil.

Soils Equal to Weakest Element.—It is a law in agriculture that a soil is equal in value to its scarcest element. There are five things that our soils are likely to be deficient in: Nitrogen, potash, phosphorus, lime and water. Now the law means that if one of these is lacking, plants cannot use the others or substitute another element for the one lacking. Sometimes there may be an excess of one element, as where one hauls much barn-yard manure on to an orchard, thus furnishing an excess of nitrogen which will induce the trees to grow too much wood or to give a late growth of leaves and wood that may lead to winter killing. The injury from an excess of one element can be overcome in most instances by an application of one or more of the other elements necessary for plant food. For example, an excess of nitrogen makes necessary more potash and phosphorus. Wood ashes are an economical source of potash. A bushel of hard coal ashes around the base of an orchard tree may make the soil unattractive to insects that crawl over or burrow at the base and later climb the tree to make "wormy" fruit, though it should be said that while some lime may come from the coal ashes there is little fertilizer value in either soft or hard coal ashes.

FIG. 70.—Plates used in studying soils.

Plates for Teaching.—The plates shown in Fig. 70 make a handy device for teaching soils, fertilizers and feeds. The plates are marked with chalk or, better, ink, and the sections numbered. There are four kinds of soil, namely, sand, clay, loam, and humus or peat. These are rarely found pure and

we name the mixed soil with the name of the predominating element first as sandy-clay, peaty-clay, sandy-loam, clay-loam, etc. These soils differ in size of particles, in origin, in texture and structure, and so on. There are many names for the soils of the different parts of the United States as glacier drift, Chester loam, Penn clay, etc. One should learn the name and characteristics of the soil of his district. This is necessary in order to know how to handle it.

Plants Disintegrate Rock.—Decaying plants furnish food for the young plants growing in a soil. But they also help to disintegrate rock and thus free plant food from the faces of the soil particles. Roots of clover may be placed between two pieces of polished marble and allowed to grow there. In a few weeks it will be found that the roots have etched the marble. It is claimed that there is an abundant supply of mineral plant food in the upper eighteen inches of ordinary soil, but the minerals are locked up in combinations with the rock particles. Air, water, heating and cooling, and acids generated by both growing and decaying plants help to disintegrate these soil particles and free mineral food for the plants. Of course, if there are no plants present to take up the food when freed, it is quickly leached or washed away. Hence we should learn that fallowing in humid climates is not a good farm practice. But it is claimed that, if a soil is kept constantly damp, it sours and there are developed amœba which prey upon the nitrifying bacteria; for this reason it is sometimes good practice to plow in late July or early August and let the plowed field lie fallow for a month or so before sowing the winter cover crop. The roots of the legumes are believed to be especially beneficial to soils where members of the grass family have preceded or are to follow. Clover and alfalfa roots seem to thrive on the excretions of corn, oats, and wheat. Clover, vetch, soy beans, alfalfa and cowpeas are believed to tear rock to pieces faster than do members of the grass family. Then, too, the legumes have on their roots the nodules of bacteria which gather nitrogen from the soil-air and store it for future crops. An acre of alfalfa is said to store twenty-five dollars worth of nitrogen each year for the first two or three years after seeding.

Why Do We Plow?—The teacher may begin this series of lessons by letting each pupil write what he thinks are the reasons

for plowing (Figs. 71–73). The answers gathered and classified probably contain the principal reasons, which are: (1) To make a reservoir for water; (2) to loosen the soil and expose as much as possible to the action of frost and rain; (3) to crumble the soil and thus make it more easily penetrated by plant roots; (4) to cause friction of particle on particle and thus tear off plant food; (5) to form ridges along the sides of hills and thus form terraces to prevent water from washing away the soil as it runs down the hill instead of soaking in near the top; (6) to cover weeds, manure and other organic matter.

From "Productive Orcharding" (Sears).

FIG. 71.—A good orchard country. Rolling land that gives good water drainage and atmospheric drainage.

First reason: To make a reservoir requires deep plowing.

Second reason: To loosen the soil and expose soil particles to the action of air applies especially to fall plowing, which should crumble the soil and set the furrow slice on edge.

Third reason: To make the soil more permeable may be accomplished by different types of plowing to suit varying soil conditions, but the same general principles and the same practice may be followed—the soil may be disked or plowed, then packed with roller or, better, packer, and then the surface

should be mellowed with one or more of the different kinds of harrows, that is, with the disk, pulverizer, spring toothed or spike toothed.

Fourth reason: To cause a sliding friction of soil particle on soil particle requires a steel mould-board plow which will bend the furrow slice abruptly so as to produce a shearing movement of the soil laminæ. That this plow with the sharply bent

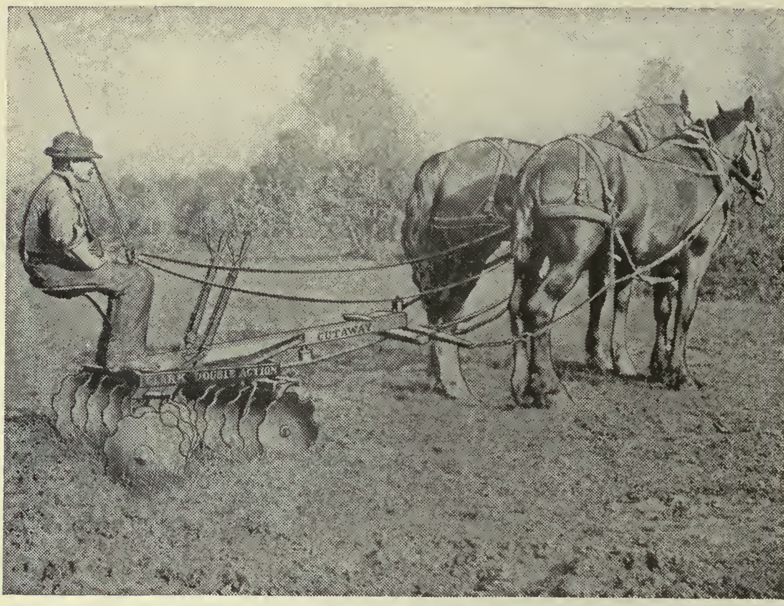


Fig. 72.—Cutaway disk.

mould-board draws harder there is no doubt, but it does correspondingly better work.

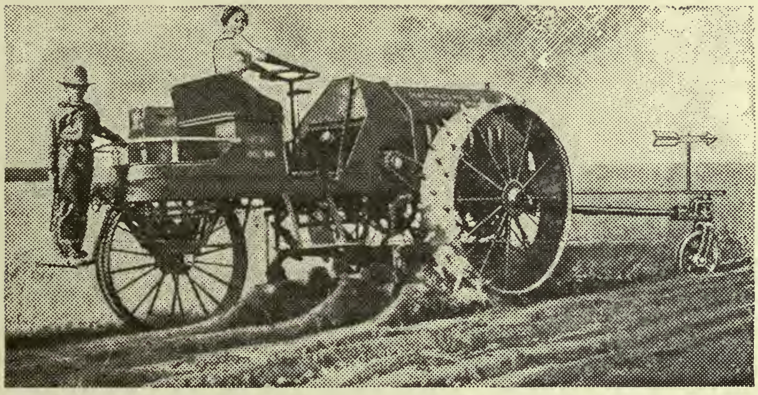
Fifth reason: To form ridges requires the furrow set on edge.

Sixth reason: To cover trash requires a wide furrow with the outer edge well turned over and deep plowing rather than shallow.

Since it is essential to plant life that water pass freely up and down through the soil, it is often very injurious to plow under a heavy coat of straw, corn stalks, leaves or barnyard

manure, which may leave a loose layer between the furrow slice and the subsoil and thus prevent the top soil from getting water from below by capillarity.

Plants may start in ground so insulated, grow for a short time, and then stop growing, wither and die. If, however, the furrow slice is wide, deep, set nearly on edge, and the soil immediately packed and disked, there will be much less danger. Heavy coats of manure and corn stalks may well be thoroughly disked into the soil before being plowed under. Heavy sod-soils are better for having their surfaces broken before plowing.



Courtesy Hackney Manufacturing Co.

Fig. 73.—A gasoline plow at work.

Coarse manure, corn stalks and such things are better applied to the pasture and meadows, where they retard the escape of moisture and become partly decomposed before being plowed under.

Why Do We Cultivate? (Fig. 74).—This series of lessons may be begun much as we did the lessons on plowing. The answers will be: (1) To kill weeds; (2) to put on a soil mulch which acts like a blanket to keep in moisture; (3) to warm the soil by letting in the warmer air; and (4) to facilitate absorption and aëration. Children should be taught that there is little use in watering plants unless a thin soil mulch or a coat of straw, hay, or leaves is placed around the plants soon after being watered. They should also be taught that injury is often done by too deep cultivation. Deep cultivation may be best

when the plants are small but, as the roots are generally longer than the stems, many lateral roots will be pulled out or cut off unless deep cultivation ceases while the plants are small.

There are many interesting problems in arithmetic which may be solved in connection with the soil and its power to retain moisture. Soil moisture is held as a very thin film around the tiny particles of soil. The children will understand this when told that each little particle wraps itself with a coat of moisture, much as a drop of water sprinkled on to a dusty floor wraps itself with a blanket of dust. Now, this being true, the capacity of a soil to hold moisture is inversely proportional to the cube of the diameters of the soil particles. That is, the finer the soil, the more moisture it holds. Professor King in his recent book, " Soil Management," figures that in a coarse, sandy soil where the soil grains average 200 to measure an inch if placed side by side, one cubic foot of such a soil has one-eighth of an acre of soil grain surface, (1) to hold hygroscopic moisture, (2) to furnish a surface to hold water-soluble plant food, (3) to furnish a surface where solution may take place. If the soil were loam it would of course be better, for if the particles measure an inch when 1200 of them are side by side, then there is in each cubic foot of the loam about one acre of soil surface. But for the water-holding capacity alone, clay is still better, for it takes 6000 particles of some clays to measure an inch. Each cubic foot of such a soil has a surface area of about five acres.

When we read or speak about the size of the soil particles, we are thinking of what the scientists call the *structure* of the soil. And when we think of the arrangement of the soil particles, we are thinking about the *texture* of the soil. Soils differ very greatly in both structure and texture and, as we have just seen, the finer the structure the greater the capacity to hold both moisture and plant food.

Soils differ greatly in their colors. The color is due to one or more of three things—the amount of decaying organic matter, of iron, or of lime. Lime and decaying plant and animal matter give the soil a dark color. Iron gives the soil a red color.

The texture and structure are apt to be due more to the kind of rock from which the soil originated and the way the soil has been managed. Both texture and structure may be studied by

having the pupils stratify the soil by pouring a small handful of it into a glass of clear water, by tearing it to pieces and examining the soil particles under a microscope, or by passing it through sieves of different but known mesh and then examining the particles that pass through each sieve.

When one becomes conscious of the importance of the fineness of soil grains and that the disintegration of soil particles by rain, frost and mechanical friction liberates mineral plant food, he will readily understand the importance of the frequent turning and stirring of the soil.

The soil should not be plowed when too dry, nor plowed,

From "Productive Orcharding" (Sears).

FIG. 74.—Cultivating the orchard.

disked or cultivated when so wet that it puddles, for then lumps will be formed which are very injurious to tilth. No farm operation is more important in the dry sections of our country than the getting out to the higher places in the spring, just as soon as the surfaces dry sufficiently, and disking them, lapping the disk one-half. If the disk is not lapped it may leave air spaces which hasten instead of retard evaporation of moisture.

The Soil Mulch.—Breaking the soil surface to prevent evaporation is the key to successful cropping in many places. A dust mulch should be kept on at all times when the soil is not frozen or covered with a crop. Next in importance to the

early spring disking is the use of disk or harrow on the freshly plowed field, and the use of weeder, drag, pulverizer or disk after each rain to prevent the formation of a crust. By thus maintaining a dust mulch throughout the growing season we conserve moisture and warm the soil by aeration, both of which are helpful to bacterial activity and to plant development.

The disking and plowing and harrowing do much to turn up insects so that the birds may get at them. It is seldom that a field that has been properly disked, plowed and cultivated is seriously injured by insects.

Thus we find that the farmer must be master of his soil at all times as to its physical condition, its chemical constituents, its biological life, and its moisture-holding capacity.

Dry Farming.—So far, what I have written about conserving moisture harmonizes with the rules laid down for the so-called "Dry Farming." We have much to learn from Mr. Campbell's discoveries and their application. If a teacher is in the semi-arid regions she should study very carefully that method of farming which Mr. Campbell and his associates advocate. Campbell's "Soil Culture Manual" will repay for its cost and the time necessary to master it. Since it requires about five hundred pounds of water to pass through a plant and be evaporated from its leaves in order to translocate enough food to mature a pound of seed, and seldom does a crop get enough water throughout the season to insure a maximum yield, a series of lessons on conserving soil moisture is well worth while.

In addition to the water film around soil particles and the moisture held in the "lamp-wick" roots below the plowing, a good soil should have much moisture held in decaying animal and vegetable matter which we call humus. This humus, which has been worked over by earthworms and the many different kinds of soil bacteria, acts like a sponge to hold water and nitrates. Humus also helps to neutralize the acids which tend to accumulate in the older fields and to injure the plants, perhaps mostly by keeping down the bacteria which would work over rock and organic matter to form plant food. While, as stated, a heavy layer of vegetable matter plowed under may do injury, especially if the season be dry, yet a light layer of leaves, plant stems, or manure will be of great help to the soil in furnishing its bacteria and earthworms something out of which to make humus.

While there may be danger at times of spreading insects or plant diseases, yet children should be taught that it is generally very poor economy to burn the finer yard rakings. Leaves and grass from the yard make excellent protection for the roots of the small fruit and orchard trees. The following season this material furnishes just the needed raw material for humus. If there is a suspicion that the leaves may contain blights, they can often be destroyed by composting. This consists of raking into piles, covering with a light layer of dirt and then pouring wood ashes and house slops on to the pile for a few months. This makes a pile of the richest kind of manure, which may be applied to the orchard or garden. Soap contains much potash which, if not applied too heavily, is very helpful to fruit plants.

Fertilizers for Different Crops.—Much valuable information may be gathered from a series of lessons on special fertilizers for the different crops. While there is danger here, as in all of the work, that we may be too dogmatic, yet if we bear in mind that the science of fertilizers is new, that the aim in the work is to awaken keen interest, that some child who does not appear to be very bright may make a discovery here that will be of inestimable value, and that we make a partial failure of the work unless we lead the children to do most of the reading and talking—if we remember all this, we cannot fail to accomplish more good than bad in this series of lessons.

The man growing special crops would no doubt like to know just what fertilizer to use for each crop. This can be answered only by experiment. The chemical analysis of his soil gives the potential plant food only, but it tells little as to what is available for the plants at any given time. No man can tell offhand just what is the most economical fertilizer for a certain crop on a certain piece of land. A man should study the results which the land and the neighboring farms are giving and have been giving. He must always have a margin of profit coming his way. If the land is giving satisfactory results compared with other pieces of land in the neighborhood, it may be said to be getting about the right treatment, but when it is giving unsatisfactory results some change of treatment is necessary. If it is an orchard in sod and not giving good results, it may be best to plow it up and plow under some cover crops, such as cowpeas, soybeans, or rye and

vetch. If the growth of trees or vines is strong and the leaves large and dark colored, it may be that there is relatively too much nitrogen, and then better fruit will follow liberal fertilizing with phosphorus and potash. Or the overgrowth of wood may be checked by seeding down for a time. Certainly, farmers need to be cautioned of the danger of spending their net incomes for commercial fertilizers and then again of the equal danger in the other direction of going for years with poor crops when a little of one or more fertilizers will bring splendid returns.

Two Theories of Soil Fertility.—There are two theories of soil fertility. These two theories have divided the soil specialists into two distinct and antagonistic schools. The first theory was announced some years ago by the great German scientist, Justin von Liebig. He found that the crops removed from the soil certain ingredients, and he believed that the soils could be made to produce indefinitely by mixing these ingredients and applying them to the soil again. His idea was that the field is like a great kettle into which we must put as much of each element as we take out if we do not wish to change the chemical contents. This theory is plausible, it is in harmony with what we learn and do in the chemical laboratories, and hence it is very generally accepted by laboratory men and by farmers who follow the laboratory scientists. Of course the theory is of value to the men who have commercial fertilizers to sell, and hence their advertising helps to keep the theory before the minds of the farmers. By this theory our lands are slowly and inevitably declining unless we put back as much as each crop takes off.

One thousand pounds of corn use about 8 pounds of nitrogen, 7 pounds of phosphoric acid, and 4 pounds of potassium. One thousand pounds of oats use 22 pounds of nitrogen, 8 pounds of phosphoric acid and 6 pounds of potassium. By the Liebig theory all that we have to do is to learn the percentages of the pure chemicals in the different fertilizers, and apply enough of each to take the place of what the crop takes off and we keep up the fertility of our soil. We find these percentages by looking at the tags on the sacks of fertilizers or the tables issued by our state examiners. We find the amounts of the different elements by referring to the tables in any standard book on soils or fertilizers. But there is danger here. There is great danger that the farmer will spend his net income for commercial fertilizers. The theory does not take account of the slow disintegration of the

soil. The theory does not give sufficient recognition to the fact that the fields may be subject to erosion and hence the commercial fertilizer which we apply may be washed on to the field of the next neighbor or, worse, into the ocean.

To counteract these dangers, Professor Whitney of the United States Department of Agriculture announced his theory in the now famous sentence, "The resources of the soil are the one immutable asset of the nation. They may be impaired by abuse, but never destroyed." The followers of Professor Whitney throw the emphasis on the facts that the soil is constantly turning loose plant food, the legumes store nitrogen, the farmer may by bad farm practice so lock up his plant foods that they are unavailable for a year or more, that the farmer must be very careful when buying commercial fertilizers to keep the net profit on his side and not on the side of the man who sells the fertilizers, and lastly and most important, the chemical analysis of the soil as given above shows that there are enough chemicals present in most soils to produce maximum crops for one hundred years. This throws the emphasis on good farm practice rather than on restoring chemicals.

There is some truth in each theory. The farmer needs to know both, and he needs to know what the different chemicals do for his plants and where he may get the largest amount of each chemical for his money.

The Four Necessary Elements.—The scientists are agreed, that, of the ten or fourteen elements which a plant needs, at least one or more of three of them may be lacking. These three are nitrogen, potassium and phosphorus. Some of the scientists add a fourth element, calcium, but not all scientists think of calcium as a necessary plant food.

Nitrogen.—Nitrogen is a very necessary plant food. It may be purchased in commercial fertilizers, (1) as nitrate of soda, mined in Chile, (2) ammonium sulphate, a by-product of the gas works, (3) dried blood and other products of the slaughter houses, (4) cotton seed meal and other plant refuse, and (5) as fish scrap. Nitrogen is very necessary for growth of leaves and stems. If you see a field with rank, dark-colored leaves you may be reasonably sure that there is plenty of nitrogen there. On the other hand, yellow leaves are apt to indicate a lack of nitrogen, though dry weather or water smothering of roots may be the cause of the unthrifty leaves. Nitrogen to induce a growth

of stems and leaves is especially needed for pastures, for hay crops, silo corn, and such garden crops as lettuce, cabbage, endive, spinach, asparagus, etc.

Potassium.—Potassium is the element which we get from potash. The cheapest source is wood ashes, decaying plant stems and disintegrating rock, especially feldspar. The commercial sources are muriate of potash, sulphate of potash and kainite from the mines of Germany. Potash is believed to be helpful, especially in the formation of the cell walls. Frequently orchards overfertilized with nitrogen may be made to bear fruit by feeding the trees more potash. So with strawberry beds and other small fruit patches. We are reasonably safe if we think of potash as necessary to the formation of large cell walls for fruit and seeds.

Phosphorus.—But we might have cell walls and little or nothing in them. We frequently find wheat making large, dark-colored stems and leaves and then setting large, heavy heads. But when harvest time comes, we find small, shrivelled seeds. What was the matter? Evidently something was wanted to induce more cell activity until the seeds were filled. It is believed that phosphorus is principally useful in inducing cell activity. On most farms we seem to get better results from the application of phosphoric acid than from the application of any other commercial fertilizer. Phosphorus is applied in a form called phosphoric acid though it, like carbonic acid, is not an acid. The commercial forms of phosphoric acid are ground rock from Tennessee, South Carolina, Florida and some of the western states. The mines in the western states are not all available yet because of lack of railroad facilities.

Lime.—Experience teaches us that most soils cropped for any length of time may need lime. This may be for either of two reasons, the soil may have become sour or it may be lacking in calcium. Lime like other plant foods is constantly being leached and washed away. We may get lime in any one of three forms from ground or crushed limestone. If the stone be heated and the carbon dioxide driven off, we have caustic lime. If water be applied to the caustic lime, we have hydrated lime. If the crushed stone be ground and not heated in the kiln, we have ground limestone, which is the form preferred for agricultural purposes, though if the hauling be too expensive we may use the caustic form.

There are two stones which are sold as limestone. One is a calcium stone with some 90 to 89 per cent of calcium in it. The other is a dolomite (calcium-magnesium) stone testing 40 to 50 per cent magnesia. Hall says the English farmers regarded this as injurious rather than beneficial, and Hilgard says, "An excess of magnesium over lime is injurious to most crops. But for neutralizing acid, the magnesian limestone does quite as well as pure calcium limestone."

Lime is especially beneficial to certain plants among which are clovers, alfalfa, beans, lettuce, celery, cauliflower, cantelоupes, onions, asparagus, and cabbage. The following crops show little if any help derived from lime: cowpeas, alsike clover, sorrel, tomatoes, tobacco, watermelons, chestnut trees, blackberries, raspberries and rye.

Both caustic lime and magnesian lime are believed to be injurious to bacteria which grow on the roots of the clovers and alfalfa. But experiments have been tried where magnesian lime gave results equal to those obtained with pure calcium lime.

For some years there have been accumulating the results of many experiments and much speculation as to the relative functions and values of calcium and magnesium in animal and plant nutrition and growth. From these we gather the following: Both magnesium and calcium are necessary plant foods, either magnesian or calcium limestone will sweeten a sour soil, but beyond that the scientists do not agree.

Magnesium.—Magnesium is essential for the growth of plants, especially seeds. Magnesium is found in and used by growing stems and leaves, and, strange to say, it has the peculiar power to migrate in the growing plant from one part to another. It seems in some way necessary to prepare the way for the action of phosphorus and other elements. While magnesium is an essential element in plant and animal tissues yet there is very apt to be a sufficient quantity in all soils and feeds. And here comes the important thing for farmers to know, namely, that an excess of magnesium in the soil acts like a poison for most plants, and an excess of magnesium in the food acts like a poison for animals. Notice that the emphasis is on the excess of magnesium over calcium which, in most if not every case, acts as an antidote for the magnesium poison (Fig. 75).

An excess of calcium for land may be obtained from a pure

calcium limestone and an excess of calcium for an animal may be obtained from the leaves of plants and from milk. Cows' milk is among the richest in calcium. What does this mean for the farmer? It means that a very profitable way to make money is to feed the limestone to the soil, which gives it to plants, especially alfalfa, which in turn may be eaten by the cows. Limestone with 98 per cent of calcium in it may be spread on land for about five dollars per ton. Alfalfa which has in its ash about 34 per cent of calcium may be obtained in most markets for less than twenty dollars per ton. Milk which has in its ash about .16 per cent calcium sells at seventy-five or eighty dollars per ton.

Fig. 75.—Antidotal relations between calcium and magnesium; distilled water as solvent. 1. Water and calcium. 5. Water and magnesium.

How to Experiment with Fertilizers.—To determine what element or plant food is most needed, select an area of level ground of uniform texture, tilth, and former treatment. Avoid underdrains, back furrows and dead furrows which might affect the yield of one of the experiments. After the ground is uniformly prepared, mark off plots and set a strong stake at the corner of each. The plots are most convenient when long and narrow and separated from each other by a 2- or 3-foot strip for a walk. A plot 8 by 34 feet is approximately equal to a square rod. A plot 16 by 34 feet—two square rods—is better. Five different treatments may be given on as many different plots. These should be compared with a check plot having no treatment (Fig. 76). The average of two experiments is more accurate, of course, than the result from one experiment. Therefore twelve plots are recommended.

Plot 1 may be treated with an even application of one pound

of nitrate of soda, plot 2 with one pound of acid phosphate, plot 3 with three-fourths of a pound of nitrate of potash, and plot 4 with 25 pounds of finely pulverized calcium limestone. Plot 5 may have an application of the first three mixed. Plot 6

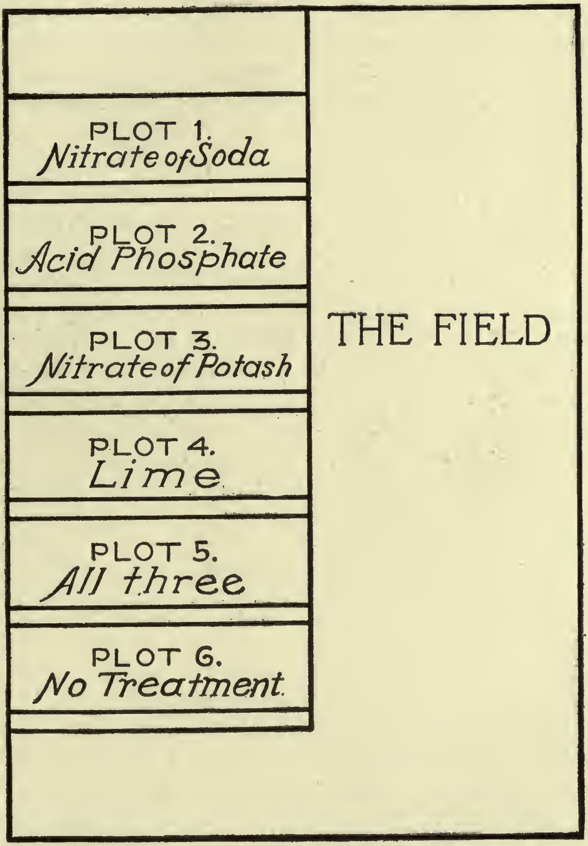


Fig. 76.—Fertilizer plots.

is to have no treatment. This treatment of the five plots is equal to a dressing of 600 pounds per acre of a high-grade complete fertilizer. On plots 1, 2 and 3 the treatment consists of a single element of the fertilizer. If there is a suspicion that the soil needs more of one element and not any of the others, the amount

of that element may be increased to something like 4 or 5 pounds for a square rod and used on another plot. By comparing the weight of the products from these strips, we may learn the relative values of the different commercial fertilizers.

There are many things that make an experiment with fertilizers go wrong. It is very hard for the busy farmer to get reliable results. But this work in school may do much to give the child something of the scientific attitude of mind, careful weighing of evidence, suspension of judgment, truthful statement of just what was found, etc.

Plants as Fertilizers.—What good do the clovers, vetches, alfalfas, cowpeas and other leguminous crops do? The answer to that question is indeed an interesting study for any school. The teacher should remember that an intelligent use of the legumes may mean a life of prosperity and happiness, or no knowledge of them may mean a life of wretched poverty for nearly one-half of the boys and girls in her classes. To begin with, it may be interesting to teach them that few plants get enough air and water to allow them to reach their best possible size and quality. Now the roots of such plants as mammoth clover and alfalfa go far down into the ground; the former may penetrate six feet, the latter nine feet, or more. After the tops are plowed off the decaying roots act as sponges to hold air and water. During rainy weather the decaying roots absorb the surplus water and then during the dry times gradually dole it out as needed to the growing plant roots. Think of placing lamp wicks nine feet long all over one's field to hold air and water until needed, then to bring it to the surface.

These are only the incidental results of the legumes. If a field has been worked for some time it may become sour or poisoned from the plants that have been growing on it. The clovers do more than any other class of plants to restore fertility to the soil. If the field gets too sour it seems that alsike is the only clover that will do well, then, after the alsike clover is plowed and the field worked a year or so, the other clovers may grow. Nor is this the great mission of the clovers. All the legumes have a function which the botanists call commensalism or symbiosis. This means that they live together for support. Now the little clover roots are the messmates of certain kinds of bacteria which differ for the different kinds of

clover; that is, alfalfa and sweet clover messmate with one kind of bacteria, other clovers with other kinds, cowpeas (Fig. 77) with another, beans with another, etc.

The farmer in the new agriculture will be just as sure to have a library on agriculture and to read it as is the teacher to have one on pedagogy, the lawyer on law, or the doctor on medicine. Perhaps the most readable book on the soil is Fletcher's "Soils." I close this chapter with a paragraph from that book.

"The greatest problem in farming is that of maintaining the fertility of the soil. The fertility of the soil is its power to produce crops. It is not mere plant food; it is water, air, sun-

Fig. 77.—Cowpeas with and without bacteria. The one at right had no bacteria.

light, plant food, temperature, soil bacteria and all of the other factors and conditions which make a soil habitable for plants.

"It is concerned with the texture of the soil as much as with its richness; and its water-moving power as much as its composition. Plant food is but one of many conditions necessary to the growth of crops, and often it is the least essential condition. The fertility of the soil is the sum of all the conditions that make it possible for the seed to sprout, the blade to spread and the ear to ripen. It is the inherent power of the soil to produce crops.

"The problem of maintaining or restoring the fertility of farm soils, then, is much broader than that of merely adding

plant food to them. It depends upon plowing, harrowing, rolling, cultivating, draining, irrigating and other tillage and cultural operations, fully as much as upon manuring, fertilizing, fallowing and the like. A really comprehensive discussion of the soil fertility should consider all the ways in which soil is handled or is acted upon by natural forces, as well as means of enriching it, and of conserving natural richness."

Enough has been said, I hope, to enable the teacher to see that much of the study of the soil has to be left until the year given to the subject in the high school or college. President Wallace of the National Conservation Congress says: "Farmers with knowledge of how to maintain and increase the productivity of the soil are soon to be the nation's greatest need."

QUESTIONS AND STUDIES

What have you learned about:

1. What the soil means to different people?
2. The origin of the soil?
3. How we may experiment to learn what element the soil needs?
4. Why we plow? How we should plow?
5. Why we cultivate and how we should cultivate?

What can you learn about:

6. The necessity for conserving soil moisture in your district and how the farmers conserve it?
7. What machines are in common use on the farms in your district? What machines are needed to handle the soil efficiently?
8. What is being done in dry farming? Is it paying?
9. What is being done in tile drainage? Is it paying?
10. What is being done to irrigate the soil? Is it paying?

References.—Your State Experiment Station Bulletins; Farmers' Bulletins No. 44, Commercial Fertilizers; No. 66, Meadows and Pastures; No. 77, The Liming of Soils; No. 88, Alkali Lands; No. 116, Irrigation in Fruit Growing; No. 187, Drainage of Farm Lands; No. 257, Soil Fertility; and No. 266, Management of Soil to Conserve Moisture; Text-books on Agriculture; Campbell, Soil Culture Manual; King, The Soil; Fletcher, Soils; Hall, The Soil; Hilgard, Soils; Hopkins, Soil Fertility and Permanent Agriculture; Hunt and Burkett, Soils and Crops; Agee, Crops and Methods of Soil Improvement; Snyder, Soils and Fertilizers; Wheeler, Manures and Fertilizers; Anderson, The Farmer of To-morrow; Cyclopedia of Agriculture.

My garden saved my life.—PARKMAN.

How I thank heaven that I a garden possess.—GOETHE.

The lady next the yard of the Downing Street School had never seen the pears ripen on her trees until the summer when 400 of the school children planted and cared for gardens of their own.—*U. S. Bureau of Education Bulletin No. 2, Agriculture and School Gardens.*

The most workable laboratory of any dimensions is the school garden. . . . The time is coming when such a laboratory will be as much a part of a good school equipment as blackboards, books, and charts are now.—ELIOT.

When we consider the fundamental relations of the race to the soil and its culture and products, and when we remember that the establishment of these relations constituted the greatest uplift of the race toward civilization, we realize that to leave soil lore out of a plan of public education is likely to prove reversion toward barbarism. The vandalism, juvenile and even adult, that renders the pursuit of horticulture in a New England town or city well-nigh impossible must be accounted a first fruit of this unwise neglect.—HODGE in "Nature Study and Life."

A school garden worth the name is not a teacher's garden, or a philanthropist's garden, but a garden worked out in thought and act by happy, purposeful children. . . . In proportion as they are being denied their freedom, the children are losing the precious chance of learning by their blunders. . . . A true educational garden can be so managed that the child faces the conditions of the real world. . . . In one well-managed garden it is the custom to "choose partners" for the work of each plot. This is certainly a step, if not a stride, toward coöperation. . . . In concrete terms, as soon as a child raises a melon and has that melon stolen, he recognizes the enormity of theft.—DORA WILLIAMS in "Gardens and Their Meaning."

CHAPTER VIII

SCHOOL AND HOME GARDENS

Education is Living.—It used to be said that education is preparation for life, but Dr. Dewey and Dr. Hanus have made popular the idea that education is living. "The only preparation for life's duties, opportunities and privileges," says Dr. Hanus, "is participation in them so far as they can be rendered intelligible, interesting, and accessible to children and youth of school age; and hence the first duty of all education is to provide participation as fully and as freely as possible." We learn by doing and reflecting on what we have done. The only way a child will ever know plants is to grow plants. This may be begun in a little box in the window ledge, carried on in the hot-bed or school garden and then in the boy's breeding plot, after which one is ready to handle a home-project and then a field intelligently.

School Gardens Not New.—Europe has something over 100,000 school gardens. There are 20,000 in Austria alone. France, Sweden and other countries do not give State aid to a school that has no garden. In Canada, where the movement is of more recent origin, the little province of Nova Scotia has over 200. Ontario gives each school starting a garden $100, and an annual allowance. New Brunswick gives each school maintaining a school garden $30 each year. The Civic League of Boston maintains something over 250 gardens for children. Chicago, Philadelphia, and other cities have made a grand success of gardens for children (Fig. 78).

Educational Value.—The educational value of school gardens is very great. The same intimate contact and real living knowledge cannot be gained from books on botany. Sound sense training comes from trying to select good seed, to keep the plants in a good growing condition, to detect insect and fungous diseases, etc. The reasoning required while learning which is the best soil and methods of fertilizing and cultivating it, or in trying to figure how to grow the largest plants or the largest number of plants on a given piece of ground, is hard to equal by the reasoning on anything found in books. Then, too, the garden work, if properly taught, gives children the desire to read

books and bulletins, and the reading in turn may be made to give one inspiration and enthusiasm to try theories or experiences found in the books or bulletins. Then the happiness that comes from being able to eat the products of his own labor, and to offer products from his own garden to some needy friend or unfortunate neighbor, is no small part in a child's development. But a garden is most valuable, it seems to me, in teaching a child the value of property and a respect for the property rights of others.

Courtesy Country Life in America.

FIG. 78.—Real living knowledge cannot be gained from books on botany.

Property and Education.—For a generation we have been trying to rear property-less children and the condition has brought its revenge. Now we pay annually $2,000,000,000, to cope with crime most of which is committed by people under twenty years of age, 85 per cent of whom began criminal careers near the age of twelve years. Almost nowhere, except with the school garden, can we develop the sentiments and feelings that come from real, vital, first-hand ownership. It was ownership of property and the hope that the children would inherit the property of the parents that created the monogamous family and

led the Aryan and Semitic races out of barbarism. "Probably the best way to teach selfishness is to try to teach unselfishness too early," says Hodge. "The passion for ownership is coextensive with life. It is as universal as hunger. Far from being antagonistic to unselfishness and altruism, the desire for ownership is their necessary forerunner, their normal preparation and embryonic phase, for no man can give until he possesses something worth giving."

Property as a character builder has been too long neglected. I find nowhere in our language an adequate treatment of this

From "Agriculture for Beginners" (Ginn & Co.).

FIG. 79.—The magic of property turns sand into gold.

subject. Dr. E. A. Ross in his "Social Psychology" has the following:

"The protection and care of a piece of property makes for thoughtfulness and steadiness. One receipt for building character in a boy is to give him a plot and let him keep what he can raise on it; give him a colt and let him have its growth in value. This property so responsive to his care or to his neglect is a standing challenge to his self-control. It admonishes him to look ahead, to plan, to sacrifice, to overrule his impulses to idle, procrastinate, or day-dream. The city parent, having nothing of this sort he can make over to his boy, is puzzled how he shall make a man of him.

"A wide dissemination of land ownership has long been recognized as fostering a stable and conservative political habit. 'The magic of property turns sand into gold,' says Arthur Young

(Fig. 79). It also turns hinds into men. An industrial or mining population, unsteadied by ownership, is altogether more easily drawn into impulsive mass action than a proprietary farming population. The man owns his home, but in a sense his home owns him, checks his rash impulses, holding him out of the human whirlpool, ever saying inaudibly, 'Heed me, care for me, or you lose me!' With the growth of great corporation-held properties in which the individual has only a fractional owner-

Fig. 80.—Experiment to determine depths to plant—an experiment worth while.

ship, property ceases to contribute much. . . . Its rôle is probably on the wane."

Plants in the School-room.—No school should be without growing plants. A chalk box or terra cotta pots (Fig. 80) filled with soil may be of service for educational purposes. One teacher planted apple seeds in the chalk box and then for eight weeks the school studied the development of the apple plant. The little trees were taken home by the children and set out to grow until they were large enough to graft.

If the end is taken out of the chalk box and a glass is slid in

where the lid was, the box may be filled with soil and beans, peas, etc., planted just inside the glass where the children may see each day what the seed is doing. This enables them to study roots and root hairs, the unfolding of the plumule, geotropism and heliotropism. No roots or root hairs will be visible unless a dark cover excludes light from penetrating the glass while the roots are growing. A larger box near the window may be a miniature garden or farm.

> Only a little shriveled seed,
> It might be grass or flower or weed;
> Only a box of earth on the edge
> Of a narrow, dusty window-ledge;
> Only a few scant summer showers;
> Only a few clear shining hours;
> That was all. Yet God could make
> Out of these, for a sick child's sake,
> A blossom-wonder, as fair and sweet
> As ever broke at an angel's feet.
>
> —VAN DYKE.

The corn testing box (Fig. 19) should be in every schoolroom. Invite the children to bring samples of their home seeds to be planted side by side with their neighbors. The little corn plants will grow fifteen inches high in the sawdust bed. They offer such a splendid chance to study root hairs, and the appearance of chlorophyll. If some soil is put on the sawdust after the need for a seed tester is past we have a first-class place in which to sprout plants with which the children are not familiar, as peanuts, grapefruit seeds, orange seeds, lemon seeds, etc. Children will never know a cotton plant by reading of it in their geographies. They may plant cotton seeds in their box at school and then transplant them to the home garden and in that way get them to bear.

School Plantings.—As spring approaches some study should be given to plantings for beautifying the school grounds (Figs. 81, 82). This requires all the thought that teachers are able to put into the subject. There should be a selection of plants that will give harmony in colors. Outbuildings should be screened or covered with vines. Places where children do not need or care to play should be made to give pleasure by their beauty. Flower beds need not be in the middle of the yard or where the children play, but they should be somewhere on the school grounds. A

fern bed may be planted on the north side of the building or in some partially shaded place. Remember the three rules for plantings, which say:

1. Avoid straight lines.
2. Plant in masses.
3. Keep the front places open.

The School Garden.—Says Hemingway, in his admirable little book entitled "How to Make a School Garden": "Probably no two school gardens can be made exactly the same because of the different conditions of space and exposure and the differ-

Fig. 81.—Why not a tree like this, loved and cared for by the children, on the school grounds?

ence in the surrounding conditions, all of which should be taken into consideration. In making the school garden, the æsthetic side should not be lost sight of, nor should it be the entire controlling element, but let the æsthetic and agricultural elements harmonize. If the grounds are small and the only space for a garden is along the fence, of course there is no choice, and if this is all there is it should be utilized; much good can be accomplished by working even in a small space."

Some teachers prefer a garden in common for the lower grades, especially the primary grades. It is well, as soon as the children are old enough, to allow them to own their own

garden, even if it is so small that only one plant can grow in it. In that case, we may have a contest to see who can grow the nearest perfect plant. If the garden is large enough for individual beds they should be marked out and a good strong stake set at each corner of each child's bed. The stake should be well driven in and the beds should have ample space for walks between them. It takes from fifteen to eighteen inches for a walk wide enough to avoid trampling on each other's beds. The beds should be narrow enough so that the children can work and weed

From "Productive Orcharding" (Sears).

FIG. 82.—Ready to set a two-year apple tree. The tree is set a little deeper than it stood in the nursery.

them by reaching in from each side. There should be no careless, slipshod work done in the garden, and the wholesome criticism of the other children should be brought to bear on the careless ones. A child should be taught to think of his garden as he should of his slate, as himself expressed—if slovenly, then the sign of a slovenly self; if neat, then the sign of a neat self.

Plants for the School Garden.—The selection of plants for the school garden will depend upon the locality, the time of the school term, the facility for some care and supervision during the summer, etc. It would be well to select some flowers that will

blossom before the summer vacation and some others that will bloom after school begins again in the fall. The former purpose would make some of the bulbs best, but they must be set the preceding fall. Some of the wild flowers should find a place in the school garden. They are very beautiful and partly through the ruthlessness of the school children they are rapidly disappearing. I know that it will be argued that some careless farmer will let his stock in and destroy the school flower beds and garden, but it is work well done if we get the children to have sufficient interest to desire to keep the fences up and the school grounds clean and beautiful.

It is well to transplant in the school garden such plants as tomatoes, melons, cabbages, etc., that may be taken home when school is out and replanted in the home garden where they may be carefully cared for and from which the child may expect some remuneration for his patience and labor. These plants, especially the melons, should be planted in halves of egg shells or in old strawberry boxes. This enables us to take them up and carry them home without seriously disturbing the roots. The work in the school garden should aim to teach each child how to grow at least one plant each year. That knowledge may be later applied in growing more than one plant at home.

The Purpose of a School Garden is a Good Home Garden.— If, as some claim, the relation of the children of to-day to the home garden is a " proverbially painful " one, and if this is due to lack of ownership and knowledge that enables one to do well at gardening, then it follows that, in so far as they can, it is the duty of teachers to overcome these obstacles by leading the children to feel the pleasure that comes from gardening where there is spontanous and creative interest. As was explained in the chapter on Seed Selection and Plant Breeding, good home gardens are very necessary to lighten the burdens of the women on our farms. It is a well-known fact that meat is an expensive kind of food, and recent tests lead us to believe that one can do as much and better work on a vegetable diet. But the human system demands variety; hence the health, happiness and efficiency of every family depend upon their being able to draw from a good fruit and vegetable garden. If what we do modifies us more than what is done for us, then the growing of beautiful flowers is necessary to the development of beautiful character.

How to Create Interest in the Home Garden.—In school, children should learn to know plants and how to grow them. Having this as a basis, the teacher may start the work in the home garden by having the children make a chart of the fruit and vegetables which they have to use at home during the year. Each pupil should make a chart and there may be a little contest to see who can get his nearest right. These charts will enable some children to see that other families enjoy fruit and vegetables twice as many months as they do. The following chart represents what we may have at our home in the northern states any good garden year. The table shows the months in which the family had the fruit and vegetables fresh—that is, not canned.

Vegetable	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Potatoes	X	X	X	X	X	X	X	X	X	X	X	X
Lettuce	....	X	X	X	....	X	X	....	....	....	....	....
Radish	....	X	X	X	....	X	X	X	X	....	....	....
Onion	....	X	X	X	X	X	X	X	X	X	X	....
Beets	....	....	....	X	X	X	X	X	X	X	X	....
Cabbage	....	....	....	....	X	X	X	X	X	X	....	....
Beans	....	....	....	....	X	X	X	....	....	....	....	....
Peas	....	....	....	X	X	X	X	....	....	....	....	....
Corn	....	....	....	....	X	X	X	....	....	....	....	....
Cucumbers	....	....	....	....	X	X	X	....	....	....	....	....
Tomatoes	....	....	....	....	X	X	X	X	....	....	....	....
Carrots	....	....	....	X	X	X	X	X	X	X	X	X
Asparagus	....	X	X	....	....	....	....	....	....	....	....	....
Parsley	....	X	X	X	X	X	X	X	X	X	X	X
Squash	....	....	....	....	....	X	X	X	X	X	....	....
Parsnips	X	X	....	....	....	....	....	....	....	....	....	X
Salsify	X	X	....	....	....	....	....	....	....	....	....	X
Ground cherries	....	....	....	....	....	X	X	X	....	....	....	....
Fruit												
Strawberries	....	....	....	X	X	....	....	....	....	....	....	....
Raspberries	....	....	....	X	X	....	....	....	....	....	....	....
Blackberries	....	....	....	....	X	X	....	....	....	....	....	....
Dewberries	....	....	....	....	X	X	....	....	....	....	....	....
Gooseberries	....	....	....	....	X	....	....	....	....	....	....	....
Currant	....	....	....	....	X	....	....	....	....	....	....	....
Cherries	....	....	....	....	X	X	....	....	....	....	....	....
Plums	....	....	....	....	....	X	X	....	....	....	....	...
Grapes	....	....	....	....	....	....	X	X	X	....	....	....
Apples	....	....	....	....	X	X	X	X	X	X	X	X
Strawberry-raspberries	....	....	....	....	X	X	X	....	....	....	....	....
Melons	....	....	....	....	....	X	X	X	....	....	....	....

Some General Principles.—Children should be taught that there is a difference between the town man's and the countryman's garden. The town man has more time to tend a little garden and his must be largely hand work. The farmer has more than enough hand work to do, therefore his garden should be so made as to admit of horse cultivation. That means that while the town man may have a little square patch for a garden, the farmer should have his garden in long rows, and while the town man may have short rows close together, the farmer can to better advantage have longer rows and wider apart. The fruit patch should be where the chickens may run in it for part of the winter. It is a good plan to disk the garden in the fall and again early in the spring and then let the chickens in to pick up the insects and weed seeds. Trash, weeds, limbs trimmed from the trees, leaves, etc., should be burned on the garden patch. The burning destroys insects and the ashes add valuable fertilizer. The strawberry bed should be where it may be mowed and burned off after each crop is gathered.

The taller plants, as corn, should be placed to the north unless they are wanted for screens for buildings or unsightly places or unless there be members of the shade-loving species which may be planted north of the corn. The rows should run north and south so as to give equal sun to all sides. Plants should be so arranged that late crops may follow earlier ones. Since plants secrete toxins or poisons for others of their kind, the same vegetables should not be planted in the same place year after year. Peas and beans grow best where the soil is inoculated with the bacteria which will form tubercles on their roots.

These principles show us that the mapping out of what plants to grow on a given piece of ground is a very complex problem demanding the best thought that can be brought to the subject. It is at all times conceivable how a better brain might make a better and more profitable garden on any given piece of land. On the opposite page (from Seymour's "Garden Profits") is given the map of the garden of a boy who made $70 on half an acre.

Should School Gardens Survive?—There seems to be uneasiness in some quarters as to the survival of the school garden (Fig. 83). Whether or not the school garden should survive depends upon what kind of a school garden it is. If the school garden

Strawberry bed	Cucumber patch	Asparagus bed
Rhubarb		
2 rows grape vines		
Herbs	Peppers Beans Carrots	
Spinach first crop	Lettuce second crop	
Peas 2 rows first crop	Cabbage second crop	
	Beets	
4 rows onion sets		
2 rows onion seed		
Early cabbage Early tomatoes		
2 rows beans first crop	Beets second crop	
12 rows potatoes first crop	6 rows celery second crop 6 rows turnips second crop	
7 rows of corn		
4 rows of tomatoes		
Summer squash		

is little more than a patch for the children to enjoy and an extra burden on the janitor, it should not survive. If the school garden is a plot with beautiful flowers grown by an unwilling janitor but flowers for which the school and especially the children get credit, the school garden should not survive. If the school garden is in the country and is a place where the children learn poorly what they would learn better by visiting a regular gardener's place, then the garden should be abandoned. If the garden is in the country and prevents the children taking an

FIG. 83.—An ornamental garden in the school yard at Juncos, Porto Rico.

active part in the home garden or, worse yet, from becoming active members of their state or the national boys' or girls' clubs, and there doing things on a larger and more scientific scale, then of course the school garden should not survive. But if the school garden is a place in town, kept by the children with no extra burdens on unwilling people, and if it furnishes an out-of-door laboratory then it should survive and become an organic part of the school.

School gardens in town seem to be more popular than school gardens in the country and for a very good reason. In the

country, children are very apt to learn incidentally all that the ordinary teacher can teach in a school garden. The growing of a radish to eat or of a dozen radishes to eat is not worth while for the country child because double the number can be grown at home with half the work. A little patch of corn doomed to partial failure because of the limited chance for cross pollination is of course worse than useless in the country where a boy may take charge of an acre or more providing he wants to.

But there is a very promising field for the rural school garden, though as yet there are few if any entering that field. That field is the field of plant breeding. Supposing, instead of pulling up the first and best appearing radish, it is marked with a little stake and left to go to seed. Supposing this seed from the earliest and best radishes is multiplied until there is a sufficient quantity to make it worth while and then is distributed to the different families represented in the school, this makes a community interested in the school garden and it makes the work worth while for the country children.

Suppose again that the teacher gets permission and goes with the interested pupils into a nearby potato field in September and there marks the hills with the most vigorous and blight-resistant tops, and suppose she follows this up at seeding time and has the hills forked out and saves seed from hills with six or more good-sized and good-shaped potatoes in each. Suppose she plants these in the school garden, has them well cared for and then distributes seed from all but those hills that she needs for the next year, this is worth while and makes the school garden a place of perennial interest. Or again, suppose she selects the best heads from blight- and rust-resistant plants in the wheat or oat field and multiplies them in the school garden, this may make the garden well worth while. She may have the pupils in one grade breed radishes, in another grade lettuce, in another grade some other garden vegetable and then the boys in the upper grades breed the grains while the girls breed flowers or take a hand in breeding an improved garden vegetable from the demands of the kitchen for better flavor, more nutrition or more attractive appearance. There is danger of untrained teachers, in their enthusiasm for something new, wasting much time and deadening interest in scientific agriculture by doing things that are not worth doing. Of course there is great need that the rural

school help give the country child his racial heritage. There is a demand that the country child be made conscious of and be given tact and skill in handling or applying laws and principles, but these may be taught to the child who spends most of his time on the farm, without the means of the school garden. The laws

Place the seeds to be treated in a pile on the floor or, if a small quantity, in a clean pail or bowl

Open the bottle of culture and add the amount of sugar called for on the label

Fill the bottle three-quarters full of cool water

Replace stopper and shake thoroughly until the jelly is broken up in small pieces

Pour the entire contents of the bottle on the seeds

Mix thoroughly with the hands, until the seeds are all slightly moist. (Add more water if necessary)

Fig. 84.—Inoculating alfalfa seed.

of averages, of variation, of mutation, of the survival of the fittest, of natural selection, of capillarity, of conservation of soil moisture, of like tends to beget like, and others are a part of the child's racial heritage which he should be given so far as he can assimilate them so that they may become the basis for his reasoning in later life. Now, if the school garden helps to make these clear, in so far it should survive as a school device for teaching.

But I believe that in plant breeding is to be found the great function of the school garden in the country. We are far behind Europe in plant breeding and correspondingly behind in average yields.

The School Gardens and New Crops.—The school garden is a good place to introduce new crops which the farmers are not growing but which they could grow to advantage. This is nicely illustrated by soy beans, cowpeas or alfalfa. In many places we find the farmers have tried to grow alfalfa, and have made three failures out of five attempts. This has discouraged them. It is necessary for the school to have patches planted the right way and the wrong way to illustrate the cause of the failures and the successes. Along with the work in the school garden, the teacher may teach the alfalfa " Don'ts " and the alfalfa poem, the reasons for growing alfalfa, and the five things necessary to grow alfalfa called the Five Alfalfa Secrets. A booklet may well be made on how and why grow alfalfa (Fig. 84). For lesson plans see Chapter XV.

WHY GROW ALFALFA ?

Because:

1. Alfalfa hay is, pound for pound, equal to thrashed oats.
2. It pays better to grow alfalfa than to buy wheat bran.
3. It requires less work to grow alfalfa than to grow other field crops.
4. Growing animals and dairy cows need lime and alfalfa furnishes most lime.
5. Alfalfa is the most drought-resistant farm crop.
6. Alfalfa does the most to improve the soil:
   (*a*) It roots deepest.
   (*b*) It gathers most nitrogen.

Five alfalfa secrets:

1. Good, well-drained soil.
2. Good, hard seed bed.
3. Good liming.
4. Good northern grown seed.
5. Good inoculation.

A DOZEN ALFALFA DONT'S

1. Don't sow on weedy soil.
2. Don't sow on poorly drained soil.
3. Don't seed a large acreage to begin with.
4. Don't say alfalfa can't be grown.
5. Don't sow on any but sweet, well-drained soil. Alfalfa is a desert plant.
6. Don't sow on any but a well-prepared, well-settled seed-bed.
7. Don't fail to give ample inoculation; both seed and soil inoculations are best.
8. Don't pasture the first year, and don't pasture when wet.
9. Don't feed alfalfa as you do hay; feed it as you do grain.
10. Don't spend your hard-earned money for protein feeds; grow alfalfa, clovers, Canada peas, cowpeas, and soybeans.
11. Don't lose the leaves; they are the best part of the plant. Use hay caps.
12. Don't give up. Many prominent alfalfa growers succeeded after some failures.

a *b*

From "Productive Farming" (Davis).

FIG. 84*a*.—Nodules or tubercles on alfalfa, showing the characteristic location on fine fibrous roots.
FIG. 84*b*.—Students studying the nodules on alfalfa roots.

Alfalfa

"What makes the landscape look so fair,
What blossoms bright perfume the air,
What plants repay the farmer's toil
And will enrich the worn-out soil?—*Alfalfa.*

What grows in loam and clay and sand,
What lifts the mortgage off the land,
What crop is cut four times a year,
And no foul weeds in it appear?—*Alfalfa.*

What makes all the stock look nice,
And brings the highest market price,
What fills the milk pail, feeds the calf,
And makes the old cow almost laugh?—*Alfalfa.*

What makes the poultry never fail,
What puts the curl in piggie's tail,
What makes the happy colts all play,
While mothers graze throughout the day ?—*Alfalfa.*

What is the crop that always pays,
And will mature in forty days
Resisting drouth and frost and heat,
Whose roots reach down some twenty feet ?—*Alfalfa.*"

QUESTIONS AND STUDIES

What have you learned about:

1. The place of the school garden in education?
2. How to make a school garden?
3. The relation of the school garden to the home garden?
4. How to map a home garden?
5. What crops to grow in the school garden?

What can you learn about:

6. An efficient school garden in your locality?
7. The farmers who are growing alfalfa?
8. What new crops should be introduced into your district?
9. Plantings that make home or school more beautiful?
10. Lessons that may be learned from the school garden?

References.—Hodge, Nature Study and Life; Farmers' Bulletin No. 218, The School Garden; No. 255, The Home Vegetable Garden; No. 408, School Lessons in Plant Production; No. 407, The Potato as a Truck Crop; Bulletins of the U. S. Bureau of Education; Corbett, Garden Farming; Meier, School and Home Gardens; Weed and Emerson, The School Garden; Seymour, Garden Profits; Williams, Gardens and Their Meaning; Hemmenway, How to Make a School Garden.

From "Productive Farming" (Davis).

Fig. 85.—Harvest in the spring-time, from the school garden.

Whatever may be the feeling of any teacher as to the desirability and interest of studying any other group of animals, there can be no difference of opinion in the matter of the birds. They are so unquestionably beautiful, they are so bright and cheerful, and their colors are so exquisite, their movements are so graceful, their behavior so varied and interesting that of all the animal world they certainly are the best subjects for nature study. Besides, it is most important that we should come to understand how intensely valuable the birds are. There seems to be no doubt in the minds of scientific students that were it not for the birds, a very large proportion of our vegetable life would be destroyed by the unending hordes of insects.—SCHMUCKER in "The Study of Nature."

There is no easier way of enticing birds in summer than by putting up boxes or similar artificial retreats for nests. . . . An admirable idea has been carried out in the Manual Training Department of the Worcester, Massachusetts, schools, in making the construction of attractive bird-homes a regular part of the course in woodwork. . . . The presence of birds near the home gives opportunity for hunting with a camera, that merciful sport which is rapidly taking the place of the more cruel hunting with a gun.—WEED AND DEARBORN in "Birds in Their Relation to Man."

CHAPTER IX

BIRDS AND AGRICULTURE

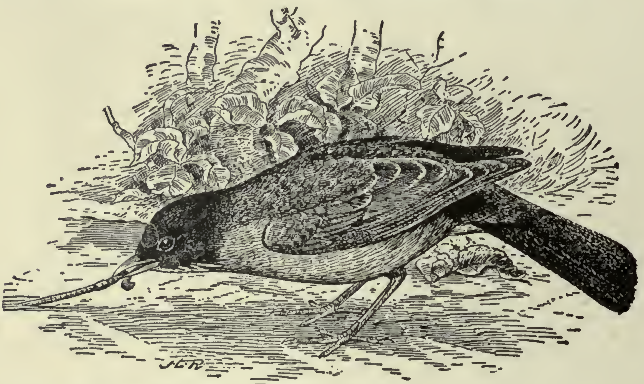
Bird Study Not a Fad.—Many people consider bird study a fad but scientists have long ago placed it beyond that. They have proven that the value of birds to the agriculturist and horticulturist is almost beyond calculation. It is estimated that the people of the United States lose annually $850,000,000 by injurious insects. The average farmer loses about one-tenth of his products; that is, if a farmer produce $1000 worth of crops, he pays $100 to feed the insects. The chinch bugs destroy over $100,000,000, the grasshoppers $90,000,000, the potato bug $8,000,000, the cabbage worm $5,000,000, the codling moth $30,000,000, and the loss from other insects and weeds on which the birds feed is enormous. Longfellow has given us a picture of what a dreary and barren place this world would be were it not for our helpers, the birds:

The summer came and all the birds were dead;
  The days were like hot coals; the very ground
Was burned to ashes; in the orchard fed
  Myriads of caterpillars, and round
The cultivated fields and garden beds
  Hosts of devouring insects crawled, and found
No foe to check their march, till they had made
The land a desert without leaf or shade.

This you say is just a flight of the imagination, but I answer that its truth is equal to its poetry and I will prove that to you by doing as Professor Brunner did for Nebraska. I will take the single State of Iowa which has 56,000 square miles or 35,840,000 acres. There are about two and one-half birds to an acre; that gives us 89,600,000 birds in Iowa. If each bird eats 25 insects or insect eggs per day—a very low average, as I will prove later—we have 2,240,000,000 insects destroyed daily in Iowa alone. One hundred and twenty thousand miscellaneous insects fill a bushel basket, and by division we find that our Iowa birds destroy 18,666 bushels of insects each day for the 150

days that they are with us. Think if you can of what would happen if "summer came and all the birds were dead."

Classification According to Food Habits.—As to their food habits birds may be grouped under one or more of three classes: (1) *Insectivorous birds,* such as wrens, vireos, warblers, swifts, martins, swallows, fly catchers, night hawks, whip-poor-wills, wood-peckers, etc. (2) *Hard billed birds,* or seed eaters, are represented by the sparrows, finches, etc. (3) *Birds of prey* include the owls and hawks. A fourth class is sometimes given to include those birds that are both seed and insect eaters, such as thrushes, orioles, meadow-larks, grossbeaks, quails, etc.



From "Birds in Relation to Man" (Weed and Dearborn).

FIG. 86.—The robin. (After Biological Survey.)

How Much Do Birds Eat?—How much do birds eat? Robert Kennicott found that a single pair of house wrens carry to their young each day as many as 1000 insects and insect-eggs. Owen fed a hermit thrush half its weight of beefsteak per day and the young thrush thrived and asked for more. Weed and Dearborn observed an old pair of robins for two hours, during which time they brought to their young 1 cherry, 1 cricket, 1 caterpillar, 1 moth, 1 harvest man, 1 tumble bug, 2 earthworms, 2 carabid beetles, 29 grasshoppers, and 8 small insects, or animals thought to be spiders. Nash fed a young robin from 50 to 75 cutworms each day for over two weeks. A family of young sparrows received, in sixty-seven minutes, 7 grasshopper nymphs and 2

spiders. Four chipping sparrows devoured 37 grasshoppers in less than one and one-half hours. Professor Brunner tells us there were found in the stomach of one quail the remains of 101 potato beetles, and in another 500 chinch bugs. The stomachs of four chickadees contained 1028 eggs of the canker worm. The stomach of a cuckoo, killed at six o'clock in the morning, contained 43 tent caterpillars. A single pair of tent caterpillars, with their young, eat from 10,000 to 12,000 apple tree leaves

From "Birds in Relation to Man" (Weed and Dearborn).

FIG. 87.—The quail eats hard-shelled insects.

each season. The stomach of one robin contained the larvæ of 175 bibio. These facts, with the fact that the young of most birds consume an average of over 25 insects each per day, are not exaggerations (Fig. 89).

Birds and Weeds.—Besides the benefit bestowed upon man by the destruction of insects, the birds help him in his war upon weeds. Rarely do we have enough water in our cultivated fields to give us a maximum crop. It takes about 500 pounds of water to mature one pound of dry matter of grain or weed seed. Then,

too, the United States Department of Agriculture has discovered that one reason why our soils are so lacking in productivity is that the plants secrete a poison for their kind. Some weeds secrete a poison for cultivated crops. I have figured, upon the basis of data given by Professor Beal, to the effect that many sparrows are found with stomachs entirely filled with weed seed, which rate would equal an average per bird of more than one-fourth of an ounce of weed seed per day. From this I find that our Iowa birds consume 1,750,000 pounds, or 875 tons of weed seed each winter. Beal and Dearborn watched a nest of young goldfinches. At the age of one week, more seeds than the product of one bull

Photo by Frank C. Pellet.

FIG. 88.—Nest and eggs of sharpshin hawk.

thistlehead were fed to them each meal. They were fed on an average every half hour. That makes not less than thirty thistle-heads consumed by this single nest each day.

Is the Number of Our Birds Decreasing?—If so, then much of our fruit growing, gardening and farming is doomed. Whether the birds of the United States are decreasing or not is a hard matter to determine, for with the opening of each new home a place is furnished for a few pair that used to frequent the homes of the older settlers. As each new fruit patch comes into bearing a few birds make it their home. We have taken a bird census at Humboldt College each year for the past five years. We find about twenty-five birds' nests in the trees on the college 80 acres and see no reason to think that there are less than that number in

the grass and about the pond below. That would make the estimate of two and one-half to the acre rather high were it not for the fact that fewer birds frequent places where there are so many people, but abound near timber land, brooks and meadows.

Even this reasoning leads us to believe that our birds are decreasing proportionately to the number of fields and fruit patches to keep clean. This belief is deepened when we realize the awful slaughter that goes on in many quarters, especially in the south where the birds winter.

From "Birds in Relation to Man" (Weed and Dearborn).

FIG. 89.—The hairy woodpecker. (After Biological Survey.)

Many colored people and the "poor whites" of the South, and the numberless "foreigners" of the North eat birds of nearly every known species as often as they can get them. From his remote ancestors, who were in a fierce struggle with the animals around them, the boy inherits a tendency to kill and to destroy; at first to destroy eggs and tear nests to pieces and later to shoot at every moving object. Then his sister, who inherits from her remote ancestors a love for personal adornment, especially by means of feathers and animal skins, induces the boys

and older men to offer in the millinery markets millions of birds and bird skins each season. A number of dealers report that their purchases each year are from forty to fifty thousand birds and bird skins each. Someone has pointed out how all this destruction could be saved by a few minutes spent in bird study each spring in our public schools. What an argument for those who advocate elementary agriculture in the public schools; and their argument is backed by the fact that, in small towns where bird study has been a regular part of the school course, the milliners refuse to carry hats adorned with birds because the demand is so small that there is nothing to be made in such stock. In

Courtesy Albert Crescent.

FIG. 90.—Wren houses.

many places the predatory tendencies of the boys have been taken hold of and organized. Boys' leagues have been formed for the protection of birds, and contests have been held where the prize went to the boy giving evidence of knowledge of the largest number of birds hatched and reared to the age where they could fly forth in quest of food and shelter. The Good Book tells us " To have dominion over them," and yet here is man after all the ages an abject slave to his appetites and his debasing instincts; and here is organized society hiring men called police to keep boys from doing mischief instead of hiring educational leaders to get boys to do helpful things. During this summer vacation millions of souls will be degraded, and millions of depredations

Photographed from life by Dr. R. W. Shufeldt.

Fig. 91.—Yellow-billed cuckoo. Adult male.

will be committed, because we hire police to spy and suppress instead of educators to lead child activity.

How to Increase the Number of Our Birds.—If our bird population is to increase it is necessary for man to cease to destroy and "right about face" and help the birds in their struggle with their enemies. Each cat is said to destroy an average of fifty birds' nests each season. This necessitates that kitty be caged during the nesting season of the birds. Some birds destroy the more useful birds or their nests. This enables the young lad with his gun to go forth to battle for his loved birdie as did the knight of old. While he is out he may make war on all English sparrows, some hawks, crows, blackbirds, red squirrels, etc., which he should have learned in his school to classify as among the harmful birds and animals. But we must not be too positive on this point, for some birds are harmful in one locality and not in another, and in some seasons and not in others. In the main, the presence of a given bird argues for the presence of some insect that constitutes its favorite food or the favorite food for its young. While this may be true, some birds do much more harm than good and hence should be exterminated, or held in check until needed.

Photo by Frank C. Pellett.
FIG. 92.—Flicker at nest-box.

But we must do more than to save the birds from their animal enemies. They are destroyed in vast numbers by storms. They may die from lack of food in March and November and during winter snowstorms, or from lack of water during the cold periods. If the boys learn in school what kind of houses are preferred (Fig. 90) by the different kinds of birds, or if they learn the food habits of different birds, the boys may find pleasure in spending some of the time that is now wasted on the streets in building bird-houses or in providing food and water. Both boys and girls may be led to enjoy tying pieces of meat, suet, soup bones with marrow in them, and other articles of food in the trees of the orchard. This will insure the birds frequenting the

orchard where, every time they come, they will spend a few minutes looking for injurious insects. But it is worth while placing food there just for the pleasure of helping the lovely little creatures and of having them with us or near us.

A man is a fool who plants a cherry tree for himself and neglects to plant a cherry or mulberry tree for his bird friends, for if the birds do not take his cherries the insects will. Birds prefer wild fruit, and in most cases will not bother cultivated fruit where there is plenty of wild fruit within reasonable distance.

Says Dr. Schmucker, in his interesting chapter on birds in "The Study of Nature": "Few sides of nature study will have a more distinct value than the work in favor of the active protection of the birds. To teachers who have a particular fondness in this direction, the Audubon Society will appear especially attractive. Membership in it is inexpensive and gives one the sense of helping on a good work. Its motto, 'A bird in the bush is worth two in the hand,' is a pleasant reversal of the old notion. The great work of this society is to foster a love for the bird world and to prevent the destruction of the birds, either wantonly or for use as ornaments for hats. To those who care for feathers on their hats, the Audubon rule suggests that we wear no feathers except those of the ostrich, whose life is preserved for the sake of his feathers, or of our common domestic fowls, which are killed for the sake of their flesh and whose feathers consequently have not caused their destruction. If there is one feather which makes a bird-lover more sad to see than another it is the 'aigrette'; that is to say, the great plumes of the male white heron. The demand of fashion has nearly exterminated this bird, and when the society had a law passed protecting the egret, as this bird is called, and sent a man to be bird warden along the coast of Florida where this bird breeds, this warden, an earnest and intelligent bird-lover, was shot to death, presumably by the plume-hunters. It seems as if only ignorance of this fact could excuse one for wearing these feathers, for, beautiful and attractive as they certainly are, it is beauty purchased too dearly."

We Need to Know More.—Perhaps I have written as though much about birds and bird life is known, but such is not the case. We are just beginning to know the beautiful creatures that

give us our symbols for angels. Few men, even among those who pass for well-informed men, can name or classify one-half of the birds which they see on a warm day in April. Still fewer of us can tell whether a bird at which we are looking is beneficial or injurious, and just how it helps or injures. A bird chart giving the time that the bird appears in the spring, the food that it is seen eating, the place for any kind of nest that it makes, etc., makes a valuable chart for the school-room or page for a bird booklet. Some bright-eyed child in our public school is going to see something this season, and see it a little clearer, and be able to tell it a little more interestingly than others have done. What a loss if the school, the community and his country fail to get his contribution! "A little child shall lead them," and we shall be "laborers together with God."

From "Birds in Relation to Man" (Weed and Dearborn).

Fig. 93.—Red-tailed hawks. (After Biological Survey.)

QUESTIONS AND STUDIES

What have you learned about:

1. Is bird study a sentimental fad?
2. How we may classify birds?
3. What birds eat?
4. What we may do to insure the increase of the number of birds around our homes?
5. Bird clubs?

What can you learn about:

6. The Audubon societies in America?
7. What the government is doing to protect the birds?
8. The law against the destruction of birds?
9. The most troublesome insects in your district and what birds prey on them?
10. What we should do with the English sparrow?

References.—Farmers' Bulletin No. 54, Some Common Birds in Their Relation to Agriculture; No. 506, Food of Some Well-known Birds; No. 513, Fifty Common Birds of Farm and Orchard; No. 609, Bird Houses; No. 621, How to Attract Birds; Kansas Agricultural College Bulletin, Vol. III, No. 7, The Economic Value of Birds; U. S. Biological Survey, Bulletin No. 43, Index to Papers Relating to the Food of Birds; No. 29, Relation of Birds to the Cotton Boll Weevil; No. 17, Birds of a Maryland Farm; No. 13, Food of the Bobolink, Blackbirds and Grackles; Weed and Dearborn, Birds in Their Relation to Man; Finley, American Birds; Chapman, Bird Studies; Chapman and Reed, Color Key to North American Birds.

The most interesting work in nature study is undoubtedly some form of animal life. Animals are more interesting than plants. The movements of plants are slow, their activity is so slight, that life in them seems to be a very different thing from what it is in animals. No other group of animals is so marvellously abundant as are insects. They swarm everywhere all through the summer. They are easy to catch and easy to watch, and are full of interest. Many of them are very valuable to us, and perhaps more are harmful; so that it is quite worth our while to know them. Of course so extended a group as the insects can only be thoroughly studied in books entirely devoted to insects.—SCHMUCKER in "The Study of Nature."

The teacher who hopes to present the subject of insect study must be a leader in doing things, not simply a director, expecting to give directions and have them obeyed. The beginner learns to do things by seeing some one who knows how, go ahead. Not only this but the instructor needs to be with the pupil to show him where to go, what to get, and when to stop. And in securing insects it is quite as valuable to know when to stop as to know when to begin.—CRARY in "Field Zoology."

CHAPTER X

INSECTS AND AGRICULTURE

Agriculture and the Present School Curriculum.—We expect that the introduction of agriculture into our schools will have a very marked effect in modifying the subject-matter of nature study, and there are those who believe that agriculture will have its most marked effect in modifying the subject-matter of chemistry, physics, botany, zoology and geography. However, it will be better for the pupil, for agriculture and for the other sciences, if agriculture is taught as agriculture with its own subject-matter and its own methods and if the other sciences are taught as distinct and separate sciences. But illustrations of a more practical nature may well be given in the sciences. In botany, for example, we wish the pupils to learn how to know plants, but the seed corn testing box (Fig. 19) makes quite as good a means for illustrating the germination of seeds as does the old planting of the bean or pumpkin seeds; and the germination box makes a better place from which to teach root hairs. In zoology we wish the pupils to learn to know animal life, but there is a good argument against throwing the emphasis on marine animals for pupils in agricultural districts. To be sure what they learn of marine animals is interesting, and something of sea animals is necessary to enable one to get a survey of the animal kingdom. But the child cannot learn everything; we must select the most useful for him.

What I am trying to say is aptly illustrated by a class in zoölogy in the mid-west. The class was having the emphasis thrown on marine animals because the teacher had been to an eastern summer school where sea life was about all that was studied. When the class came to insects, there was hardly a suggestion that insects were of vital interest to the people of the district. One boy had learned of Professor Snow's work. He saw a field of wheat that was being devastated by the chinch bugs. The boy sent to Professor Snow for some of his cultures. Two little dead bugs covered with a white mould came in a cap box. The boy was instructed by Professor Snow to gather other chinch bugs and fill the cap box, then to wait until the bugs were well

inoculated and empty them into a baking-powder box, fill it nearly full of fresh chinch bugs, wait until all were well inoculated and then sprinkle one or two to a square rod around the wheat field. The boy followed directions. The bugs in the field gradually disappeared, the wheat brightened up and the farmer was thankful indeed to science for what it had done for him. But though the boy was taking zoology at the time, he failed, and his teacher was unable to make connections with the field work and the zoology. That boy actually received a lower mark because he was more interested in the outside work, he spent some extra time at it, and failed to make connections with either zoology or botany.

Insects and Nature Study.—Insects offer much valuable material and interesting work to be done any time of year in nature study. But again the teacher needs to be cautioned not to follow a book, unless it be a book like Schmucker's "Study of Nature," in which she is advised to teach the real object and to teach it at such times as she is able to find material. The teacher of insects must have that important attribute of a cultured man or woman which we call open-mindedness. All squeamishness must be put aside and we must go back to nature as little children. They like to handle insects. They do not think of insects "biting." Then, too, teachers must be able to say frequently, and openly and honestly, "I don't know," for there are many things about insects that the most learned scientists do not yet know. No teacher should hope to learn to identify all of the insects, to learn where each spends each period of its life history, or to know offhand how to control each insect. But a teacher should know what books treat of the information which a farmer may need. She should see to it that her library is supplied with one or two good books on insects. Among the good books are Saunder's "Insects Injurious to Fruits," Smith's "Insect Friends and Enemies," and Comstock's "Manual for the Study of Insects."

Teach the Importance of the Subject.—When beginning the study of insects, plant diseases, birds, weeds, or anything else in agriculture for that matter, the teacher should aim to impress upon the minds of her pupils the importance of the subject. In the United States we lose $850,000,000 each year from insects alone. We spend from $3,000,000 to $5,000,000 annually,

spraying to control one single insect—the codling moth (Fig. 104). In recent years we have introduced the San José scale from China, the cotton-boll weevil from Mexico, and we have spread the Colorado potato beetle across a continent. A list of some of the more injurious insects and the injury they do is given in the chapter on birds.

Take Advantage of Transient Interests.—If we are to make agriculture popular in our schools, teachers must instruct in the fundamentals first; the special and technical may follow as circumstances demand. By that we mean the general methods of combating insects and plant diseases should be given always, and, when the presence of a certain disease or insect makes it necessary, a series of lessons and a critical study of that particular disease or insect may be given. It is doubtful if, with all our spraying and insecticides, we shall ever be able to check the ravages of the insects unless we can improve the farm practices. At least this seems to be the conclusion of the enlightened European nations that have had similar experiences. The Pacific Coast States are far ahead of the Eastern and the Corn Belt States in recognizing the necessity of a man's seeing that his whole township, county, or State is cleaned up in order for him to keep his own farm free from insects and diseases.

Nature's Beautiful Balance.—Everything has its enemy. Nature would maintain a beautiful equilibrium if she could, but man wishes more than his natural share and hence seeks to destroy the competitors of the plants and animals which he desires to use. One of the most important lessons that man has to learn is that he can control his enemies most easily and economically by increasing their enemies. The first step in controlling insects and bacteria is to recognize which ones are beneficial and which are injurious. The second thing to be done is to learn the signs which indicate their presence. Of both of these matters we shall have more to say later.

Rotation of Crops the First Farm Practice.—The first farm practice to be recommended is the wide rotation of crops. This means, where possible, a complete change of plant families. Some insects live on one kind of plant and some on another, therefore, if a field be plowed and devoted to entirely different plants for a long enough time, the first insects starve for lack of proper food. Some insects and some plant diseases live on corn,

some on wheat, some on oats, and others on potatoes. Still others live on corn and the small grains but not on potatoes and tomatoes, or cowpeas and clovers. If the farmer wishes to benefit by this wide rotation-of-crop practice, he must put in as widely

FIG. 94.—Wheat cut down by Hessian fly. This fall wheat was sown too early—a bad general farm practice.

differing crops and make the cycle as long as is found by his Experiment Station to be most advantageous. Then, too, he must know when to plow and when to plant. The wheat fields

FIG. 95.—Wheat on adjoining farm to Fig. 94. It was good farm practice to sow this field late.

shown in Figs. 94 and 95 are on adjoining farms. The difference came from the fact that one man knew that, to avoid the Hessian fly, he must plant late.

Clean Culture the Second Farm Practice.—The second farm

practice to be recommended is thorough, frequent and clean cultivation. The old adage that one acre plowed in August equals two plowed in September, and one plowed in September equals two plowed in October, and so on, applies especially to the destruction of insects, weeds and plant diseases. Disking immediately after harvest helps in two ways: It conserves moisture and thus encourages the multiplication of useful bacteria, and it turns the insects up to the devastation by birds and storms. Many of the insects injurious to fruit pupate in sod, and hence clean culture in an orchard is often effective in ridding it of the insects that cause "wormy fruit." Wire worms, white

From "Fights of a Farmer" (Snyder).

FIG. 96.—Road with well-kept hedges on either side, all vegetation between closely mown or pastured. [This affords the least possible protection for destructive insects during winter.]

grubs, canker worms, and corn root lice are among those insects that may be controlled by clean culture. But clean culture has another meaning. Many of the insects and diseases live for part of the season in old and decaying weeds, pieces of bark, twigs, cuttings, etc.; now clean culture means that these be thoroughly raked and burned. Children should be taught that each "wormy" piece of fruit left in the orchard may mean two hundred "wormy" pieces next year.

The Third Farm Practice, Decoy Crops.—A third farm practice is the planting of decoy crops. This consists of planting, earlier or later than the main crop, along the edge of the garden or field, strips on which the insects will gather. Then the decoy

plants and insects are destroyed together, sometimes by spraying with kerosine oil or poison, sometimes by burning, and sometimes by plowing under so as to smother the insects or diseases. A strip of wheat sown in August will often catch the insects of a whole field, and then the wheat on the strip may be destroyed with the insects just before the winter wheat is put in. A strip of mustard or of early cabbages may be used to catch the insects and then be destroyed before they can reach the main crop. Radishes, pumpkins, and other seeds are often planted near the melon hills to catch the melon bugs; then bugs and decoy plants may be plowed under, burned, or sprayed with oil, Paris green or other preparations.

The Fourth Farm Practice, Pasturing.—Another farm practice to be highly recommended is the pasturing of an infested field with sheep, hogs, horses and cattle; also the encouraging of the poultry to range as widely over a field as possible. The sheep may eat the weeds that the insects would hibernate on, the hogs may root and eat the grubs, the horses and cattle keep the grass down so that the birds and sunlight get at the insects and diseases most of which thrive best in the shade. One day I found seventeen cut-worms under one cock of hay, and an old Plymouth Rock hen, which for half an hour had been following the men who loaded the hay, ate them all. The next day I found thirty-six cut-worms on the ground from which one cock of clover had been taken; the same old hen ate all and after that lived to be an excellent fall egg layer. Turkeys are better insect destroyers than chickens. It may be necessary to give the caution that many pastures are left down so long that they become infested with insects and diseases peculiar to pasture crops. These old fields can often be made to double their yields by being plowed up and planted to corn or potatoes for a season or two.

The Fifth Farm Practice, Good Planting.—A fifth general farm practice is the planting of crops at a time, and under conditions, when they will get a strong and vigorous start. Corn planted too early on sod gives the cut- and wire-worms (Fig. 96) too long a time to work on the weak and tender plants. Small grains on weak soil often become the prey of diseases and insects that do not injure the same grain on good soil (see Figs. 94 and 95). A soil deficient in one element of fertility often induces a growth that is peculiarly susceptible to disease.

The Sixth Farm Practice, Plant Breeding.—The last general farm practice to which I wish to call attention is the selection of resistant plants and varieties. Individual plants of like species differ greatly in their resistant (see Fig. 23) powers, and varieties differ still more. The Experiment Stations are spending much thought and money on this subject and the farmer boy should be placed in contact with the results as soon as possible.

One Insect as a Type Study.—At any time when opportunity offers it is well to take up the critical and thorough study of the life history and habits of some one insect that is of economic interest to the particular locality in which a school is located. Believers in the old faculty, psychology, will find in these exercises splendid material for cultivating the perceptive faculties, for it requires keen sight, good hearing, delicate touch, and often an acute sense of smell to detect the presence of some of the insects. Their preservation, care and feeding will exercise observation, memory and imagination, and no other objects in nature offer better material for the reasoning faculties to work upon. Material for the study of insects may be found everywhere (Figs. 96, 97) and at all times of the year. Insect work may be used for the application of lessons from the other branches. Compositions, problems in arithmetic, work in geography and reading may be easily correlated. Telling in a plain way just what the insect has done, may do, or has been known to do; figuring on the damage done, what percentage of the leaves or plant is injured and what the value is; using the maps to find the place from which the insect originally came, where it was introduced and over what area it has spread; this and similar work is valuable and adds interest.

Fig. 97.—A school collection of insects. Material for teaching may be gathered almost anywhere.

A series of lessons on the differences between an insect, a bug, spider, craw-fish, etc., may be given by way of introduction. Then the children should become clearly conscious of the fact that most insects have four stages in their life history. The

aim is to enable the child to know thoroughly one insect so that by analogy he may reason intelligently on other insects.

Stages in Life History.—Nearly all insects begin life in an egg. This egg hatches into a *larva,* or what the children call a "worm" when it is found in apples and other fruits and vegetables. The third stage is the one after this larva has woven a mile or so of silken thread around itself, making a *cocoon* in which it apparently goes to rest for a time. From this cocoon the *pupa* emerges as an adult fly, butterfly or moth. School children generally find the work easiest and most interesting by beginning with the cocoon, which may be gathered whenever found and kept in surroundings resembling its natural hibernating place, but under glass so that the children may watch it as it emerges and develops for the first few hours thereafter.

The Subject of Sex.—The teacher will have to use her own judgment about having the sexes mate before the children, in which case the function of the sexes would have to be explained. Many farm children are injured by having the sexual passions stimulated prematurely or too strongly by seeing the mating of farm animals; others are injured by never knowing about such things until they learn of them from the low and degraded. It would seem that the best time for such discussions is in the presence of a pure-minded mother or father before the child reaches the adolescent age. It is a delicate point, but the male and female must mate before the female can lay fertile eggs. Having secured fertile eggs, the pupils should keep them until they hatch into the larvæ, and keep the larvæ fed until they form the cocoons and become pupæ again.

After the pupil has learned the life history of one typical insect his course in agriculture parts company with the old zoology, where men vied with each other in trying to see who could gather, mount and classify the greatest number of specimens—a rather refined kind of pure egotism. The student of agriculture seeks rather to find how many kinds he can learn to identify and control, so as to increase the useful ones and hold in check the injurious ones.

The House Fly.—One of the most common insects is the house fly, and yet one will be surprised to learn how few pupils or teachers are sure that they are looking at, or have seen a house fly (Fig. 98). There are many garden insects that look much

like house or horse flies; as, for instance, the chalcis fly, the saw fly, the rose-slug, currant-worm fly, etc.

However, the important thing is not learning to identify any particular kind of fly. There are a number of horse flies, all of which have a piercing apparatus with which they make an opening through the skin of the animal and then suck the blood. Some of these, as the little horn fly, are recent importations. As Professor Hodge says, "It is not intended that school children shall make breeding experiments with flies; such disagreeable work may be left for the specialists, but the lessons which every child should learn are that filth breeds flies and that, in spite of the best we can do in keeping our premises clean, we need the help

From "Our Insect Friends and Enemies" (Smith).

FIG. 98.—The house fly, *Musca domestica:* larva with details at right, puparium at left.

of insectivorous animals. Ask the children to study what the swallows are doing when circling about a herd of cattle; what the phoebe and king birds do when they dart from their perch and you hear their bills snap. What other birds eat flies? Let some child who has a tame bat see how many flies it will eat. The writer had one that ate 243 at a meal, but it died soon after. Let the children watch the toads about the back-door step, to see how many flies one of them may eat in a day. One little girl counted while a toad snapped 128 flies within a half-hour. A tree frog is a most interesting pet and a wonderful flytrap."

Flies breed in incredible numbers in manure derived preferably from horses. It is claimed that 1200 will emerge from a single pound of horse manure. The female flies lay their eggs

in filth and there the eggs hatch into larvæ, called maggots, which are readily eaten by birds and chickens, if the filth on the roads and meadows is accessible to them. The females coming from this filth, after laying their eggs, are a dangerous source of contagion. Howard claims that flies are the principal agents for the spread of typhoid fever. We are told that a tubercular cow may void 3,700,000 live tuberculosis germs each day. Human beings afflicted with contagious diseases void many germs. Flies may, and do, spread many of the germs enumerated.

Fig. 99.—A Hodge fly-trap. A good home project and manual training exercise. One of these traps has been known to catch a half bushel of flies from the barn in one week. A desk fly-trap stands at the right.

As will be readily seen, there are two important ways of controlling flies, first by the proper care of excreta, and second by destroying the flies (Fig. 99). If excreta is covered with fresh earth or lime, the insects will not frequent it. Ashes do nearly as well as lime. Land plaster used in the horse stable more than pays for itself in fixing the nitrogen in the manure and at the same time helps to keep down the number of flies. If manure is spread, as fast as made, on meadows or pastures the farmer will get the most possible from his manure and at the same time he will avoid breeding places for flies. Manure from the milking yard and barns, if stored, should be easily accessible for the poultry and hogs. The use of fly poisons and fly paper is of course to be recommended. The cone fly trap has been found to be a very effective means of keeping down flies, especially if used early enough in the season.

"The house fly has a number of natural enemies," says Chittenden, "the common house centipede destroys it in considerable numbers; there is a small reddish mite which frequently

covers its body and gradually destroys it; it is subject to attacks from hymenopterous parasites in its larval condition, and it is destroyed by predatory beetles in the same stage. The most effective enemy, however, is a fungus known as *Empusa muscæ,* which carries off flies in large numbers, particularly toward the close of the season. The epidemic ceases (in the north) in December, and although many thousands are killed by it, the remarkable rapidity of development in early summer months soon more than replaces the thousands thus destroyed." As nearly as we know it, the life history of a fly is as follows: "Egg, from deposit to hatching, one-third of a day; hatching of larva to first moult, one day; first to second moult, one day; second moult to pupation, three days; pupation to issuing of adult, five days; total life cycle, approximately ten days." If each female lays the average number of eggs, *i.e.,* 120, and if one-half of them hatch females which reproduce in ten days, how many flies descend from a single pair in one season, from April to November? Minnesota Extension Bulletin No. 43 says over 214,557,844,320,000,000,000,000 flies would be produced from one female and her descendants. A Hodge fly trap makes a good manual training project, and the making of one and the keeping of the home place free from flies makes a first rate home project.

The Mosquito.—Another common and injurious insect, that costs the farmers thousands of dollars in blood each season, is the mosquito; of which, as in the case of the flies, there are a number of species. Again, like the flies, they multiply each spring from a very few adults that survived the winter. The female mosquitoes lay their eggs in water and those in warm, stagnant water hatch into larvæ known as wrigglers. "But," says Comstock, "it is probable that some species breed in the ground, for mosquitoes occur in arid regions far from water." The ordinary life cycle is ten days and each female, as far as we can learn, lays an average of 200 eggs. Professor Hodge tells us that a single pair, in one average season of 180 days, will produce 2,000,000,000,000,000,000,000,000,000,000,000,000,000 young.

We know that mosquitoes spread a number of diseases, among which are malaria fever and yellow fever. The mosquito, like the horse fly, has a piercing apparatus and injects into his vic-

tims a poison which will keep the blood from coagulating while he is drinking. It is believed to be this poison that causes the swelling after a mosquito "bite."

Mosquitoes, like the flies, have a number of insect enemies. The beautiful four-winged dragon-fly (Fig. 100) that we see poised so delicately on weeds and flowers eats large numbers of mosquitoes. Frogs, snakes, minnows, etc., eat large numbers of both eggs and wrigglers, hence fresh water inhabited by these is rarely a source of the mosquito pest. But the most effective method of control seems to be the draining of every stagnant pool and pond, the screening of old barrels (Fig. 101), cisterns, etc., containing soft water, and the application of a small quantity of kerosene oil that may be wafted back and forth on the water that cannot be drained. Nothing but ignorance or indolence can account for the neglect of some farmers to provide good screens for windows and doors to protect the inside of their houses from flies and mosquitoes. Probably the mosquitoes, like the flies, are destroyed in vast numbers by some fungous enemy, but it remains for some bright-eyed boy or girl to discover it and to describe it in an interesting way.

FIG. 100.—Dragon-fly, a mosquito eater.

Fleas, Lice and Bedbugs.—Fleas, lice and bedbugs are insects that live upon the blood of man and other animals; they flourish commonly in homes of ignorance, squalor and carelessness. Each of the farm animals, however, is apt to attract a species of lice peculiar to its kind. In the chapter on pets (under cats and dogs) I mentioned one way of ridding a place of fleas. Chittenden tells us that Professor Gage, in order to rid a building of fleas, "tied sheets of sticky fly paper, with the sticky side out, around the legs of the janitor of the building, who then for several hours walked up and down the floor of the infested room, with the result that nearly all the fleas jumped on to his ankles, as they will always do, and were caught by the fly paper."

Professor Hodge thinks that superhuman tact and good-nature are necessary to enable a teacher to handle successfully the bedbug and lice lessons. Unless their presence in the school

makes the lessons necessary, it is probably better to pass them; but when specimens are found, the opportunity should be taken advantage of to give lessons that will never be forgotten. There are many excellent preparations on the market that destroy very effectively such pests. Some good antiseptic soap should be in every farmhouse at all times. The hair should be washed at least once a month, and in case of bruises, scratches, cuts, also after handling or picking chickens or when one has been in contact with filth on buildings or stock, some antiseptic should be used

Courtesy College of Agriculture, Porto Rico.

Fig. 101.—Covers for rain barrels at Mericao public school. A good device to keep out mosquitoes.

in the bath water. This is the best insurance against both these loathsome pests and also tetanus, the germs of which give lockjaw. The tetanus germs live in manure and hence a scratch from an old nail, piece of wire or harness buckle may be very dangerous unless the germs are destroyed by some antiseptic.

There are also good preparations on the market for the different farm animals. The dipping of the farm animals once or twice each season is a good practice and is becoming popular. Some farmers nail old rags saturated with melted lard or tallow

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mixed with kerosene on to rubbing posts. These padded rubbing posts for cattle and hogs are said to be very effective in holding in check fleas, lice and some diseases such as calf itch, etc.

The Clothes Moth.—Both the farmer and the people in town must make war against the clothes moths. Though not generally considered so, the presence of this insect is due largely to neglect and ignorance of its breeding habits. Let the children discuss freely the losses sustained at their homes from this pest. Then send them home to search in cracks, sheds, and places where old woollens have been neglected or stored, also for bunches of hair or fur that may be lying around, as woollens, fur, hair, etc., are the breeding places of these insects and one of the first things to teach is that all such things should be carefully gathered and burned. Things which we wish to keep from the moths should be tied tightly in cotton cloths, or better, placed in paper sacks which are then pasted shut. Furs and woollens may be stored in trunks that are known to be free from the insects and then the openings of the trunks may be pasted shut. Moth balls, cloves and tobacco are also helpful in driving the pests away, but one does not like the odors afterwards.* Tight screens for the house are very necessary in enabling us to control clothes moths.

There are a number of other household insects such as the *buffalo moth, carpet beetle,* etc., the presence of which may make necessary one or more lessons on each. Someone has said that " next in value to knowing a thing, is the knowing of where to find out about a thing." We do not expect children to learn everything about insects, but we should teach them that whenever the United States Department of Agriculture or their Experiment Station issues a bulletin about a certain insect it is because that insect is doing great damage, and if the insect is known to be present in their locality the bulletin is worth reading.

INSECTS OF THE FIELD AND GARDEN

The Corn Root Worm.—Professor Holden estimates that the ravages of the corn root worm cause an annual loss of 200,000,000 bushels of corn in the Corn Belt States alone. He says, " Next

* It is claimed that a mixture of redolent, strong-smelling spices, such as cloves and cinnamon bark, used freely about places where woollens and furs are stored, will prove quite as effective in keeping clothes moths away, and will be much less offensive to wearers of the garments.—Davis.

to poor seed corn, the corn root worm is the greatest source of loss to the corn crop." This so-called worm is a small white larva about half an inch in length and a little larger than a pin. The eggs laid by a beetle are somewhat larger than a double pin-head. They are laid at the roots or foot of a growing corn stalk during August and September. The eggs hatch during June and July. In case the field is not planted a second time to corn, the larvæ starve, but if they can get at corn they eat their way into the roots and thus cut off the root, the plant's support and its source of food supply. Trained observers easily detect the presence of the worm by the peculiar bend in the corn stalks. The lack of support causes the corn to lean decidedly at the ground but heliotropism causes the tops to seek the sun and hence the double curve. The remedy for the control of the corn root worm, as suggested earlier in this chapter, is a wide rotation of crops, clean culture, fall plowing, the presence of birds and the planting of strong, vigorous seed that will enable the plants to withstand some damage and yet produce a crop.

Next to the corn root worm, the *corn root louse* or aphis causes the greatest loss. The aphides are generally associated with ants which use the aphides for their cows. The ants carry the aphides to pasture at the foot of some growing corn. The aphides live on the sap of the roots and the ants make regular trips to their cows in order to suck the secretion which the aphides exude on being disturbed by the ants. As the aphides cannot live on other crops, especially the clovers, the first remedy to be suggested is rotation of crops. The second remedy is clean culture. It has been found by experiment that the number of root lice can be reduced between 80 and 95 per cent by disking the ground each week before planting, as recommended in the chapter on soil, for the conservation of spring moisture. That is, where ground was disked as soon as the surface dried in the spring and then was disked once each week until planting time, the root lice were found to be only 5 to 15 per cent as numerous as on adjacent soil left undisked. The use of the weeder or harrow after planting helps to confuse the ants as to where their cows are and helps to expose the aphides to the destruction of birds.

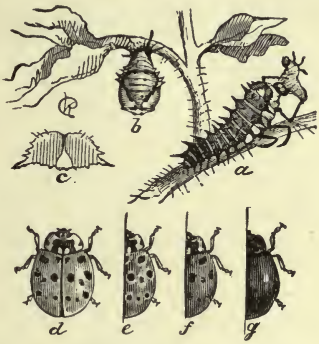
Other Aphidæ.—Besides the corn root louse, there are many other species of the *Aphidæ.* They frequently make frightful

devastations on all kinds of grain and vegetables, even the trees are at times stripped of their leaves, and foliage is taken from the rose bushes by these little green plant lice. These aphidæ have some peculiar habits and characteristics. The young that do the injury to the crops are born in insect form directly from the body of the mother. But these young have no wings and hence would spread very little were it not for the fact that the sexual forms pair and then the female, which may or may not have wings, lays two or three eggs from which winged insects hatch. In the egg form the species live through the winters of the northern States.

Right at this point may be given a series of lessons on the wonderful adjustment or equilibrium of nature. The successful agriculturist must be a better geographer than our schools have turned out in the past. The multiplication of these insects and the weather are closely related. These insects live in a temperature as cold as 8° F. above zero. Now these insects are held in check by a small fly-like insect that deposits its egg through the skin and into the vitals of the plant lice. But the plant lice's enemies do not live with a temperature down to the freezing point. The lice live during the late fall and warm winter days, and go on giving birth to young. But their enemies stop activities early in the fall and do not begin until late in the spring. Fortunately the enemy lays many more eggs. But this climatic control explains why after a warm winter and a late cold spring the plant lice can destroy the wheat crop over whole states before they are destroyed by their enemies. To many people the plant lice seem to come and go mysteriously, but the good geographer sees order in it all and that is the first step toward learning how to control these enemies.

The aphidæ may be held in check on fruit trees by increasing the number of lady beetles, small birds, and by spraying with a soap-tobacco solution, the formula and directions for which are given in the spray calendar sent by your Experiment Station. But there is a little white, or woolly louse which one should be very, very careful not to introduce with nursery stock. It is most harmful to the apple trees. If it is once introduced there is nothing better to do than to cut down and burn every affected tree, twig, leaves and all. As the man said of his mother-in-law, "cremate, embalm, and bury; take no chances whatever."

The late Professor Slingerland, in his excellent treatment in Bailey's "Cyclopedia of Agriculture," says: "In this warfare that man must wage against his insect foes, he should not forget that nature has provided active and often very effective destroyers without which man could not grow crops, or even exist himself. Were it not for the many little enemies of plant-lice these insignificant creatures, with their wonderful powers of multiplication, would soon overrun the earth and destroy all vegetation, thus robbing man of his primary food supply. Among the forces of nature which thus aid man in his insect warfare may be mentioned strong winds, sudden changes of temperature in winter, rains, and forest and prairie fires. Then among the plants and animals there are some very efficient insect destroyers. Bacteria and fungi often kill a large proportion of army worms or chinch bugs that are devastating crops. Many of the birds feed largely on insects and should be encouraged to stay on every farm, for they are among the most efficient of nature's insect destroyers.



From "Our Insect Friends and Enemies" (Smith)

Fig. 102.—15-spotted lady-beetle: *a*, larva; *b*, pupa; *d-g*, adult varieties.

"But it is among their own kind, the insects, that insect pests find their most destructive foes. Vast numbers of insects, some so tiny that several of them can live inside an insect egg (codling-moth egg) not larger than a pin's head, are constantly preying on the insect enemies of man's crops. . . . A little lady-bird beetle (Fig. 102) saved the citrous industry of California. . . . And it would be impossible to grow wheat in many parts of the United States were it not for the tiny insect parasites of the hessian fly."

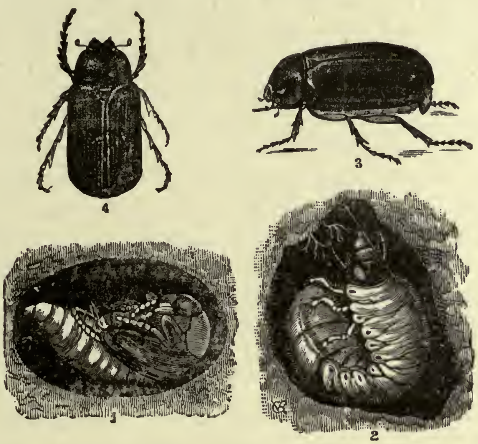
Experiment Stations and the National Department of Agriculture are spending thousands of dollars each year to discover natural insect and plant disease enemies. Shall we allow a boy to become a man and the man to become a farmer without his school putting him in touch with this information?

Cut-worms.—Cut-worms are found in and near sod-ground.

They eat the vegetables of our garden as well as our corn. The worst feature of their mischief is that they do not eat the whole plant but cut it off just beneath or above ground. Thus a large number of plants are necessary to satisfy each larva. Their ravages are most noticeable on crops planted in hills as corn, cabbage and tomatoes. They are known also to girdle young trees. They do their greatest damage to corn on the first-sod crop. There are many species of these rascals but the owlet-moths are mothers to them all. One of these moths is the dirty gray moth that flies so frequently against our lights during the spring months. The moths lay their eggs in the ground during the summer. The larvæ soon hatch and begin to feed upon the stems and exposed roots of plants, but as they are very small the first season their ravages are little noticed. As fall comes on, the half-grown larvæ burrow into the ground where they spend the winter. They emerge again in spring as larvæ about the size of a child's little finger. They feed at night. Let the children go out into the garden and find cabbage, tomatoes or corn cut off, then look under the surface of the ground for the cut-worm. He will generally be found just under the surface near his mischief. One way to catch and to control them is to lay fresh pie-plant (rhubarb) leaves around on the ground in the cabbage, tomato or sweet corn patch. The cut-worms do their mischief and then crawl under these leaves to spend the day. I found twenty-three under the pie-plant leaves in my garden one morning. Another way to trap them is with the dibble used to make holes for the cabbage and tomato plants. Make holes about eight or ten inches deep with vertical sides, into which the cut-worms will fall but cannot draw their fat, lazy bodies out again. For field practice frequent cultivation, late fall plowing or disking, frequent rotation of crops including clover especially, and strong seed are to be recommended. The cut-worms like weak, tender plants best. Frequently it is a good plan to drill in a few extra rows along the edges of the field, midway between the regular field crop rows, so that the cut-worms, squirrels and gophers will have a double amount on the edge of the field and hence do half as much injury to the regular crop. The chickens and the birds must be asked to help us in our warfare against the cut-worms. The little striped gopher destroys many cut-worms each day.

The White Grub.—The white grub worm is another pest that

does much damage to both field and garden crops. Farm children know him as the brown-headed, white, fat "worm" found in well-rotted manure during the summer months. He does most damage on old sod or well-manured ground. The eggs are laid in the ground, preferably in sod or rotting manure, and the larvæ or grubs hatch and live for two or three years on organic matter, mostly plant roots. The eggs are laid by the May-beetles, or June-bugs (Fig. 103), which are the brown beetles that make a noise like a swarm of bees around trees, during the spring evenings. These beetles are the ones that come buzzing into the room on a spring evening and whiz around the light. The



From "Economic Entomology" (Smith).

FIG. 103.—May-beetle. 1, pupa in earthen cell; 2, larva or white grub; 3, 4, beetle, from side and above.

beetles themselves often do serious injury to the foliage of young trees from which they may be shaken on to sheets or blankets and then gathered and burned. But the larvæ do the most injury.

Says Comstock: "We have known large strawberry plantations to be destroyed by them, and have seen large patches of ground in pastures from which the sod could be rolled as one would roll a carpet from a floor, the roots having been all destroyed and the ground just beneath the surface finely pulverized by these larvæ. No satisfactory method of fighting this pest has been discovered as yet. If swine are turned into fields infested

with white grubs they will root out the larvæ and feed upon them. We have destroyed great numbers of the beetles by use of trap-lanterns, but many beneficial insects were destroyed at the same time." As the larvæ live near the surface, clean and frequent cultivation is necessary, also the presence of gophers, which eat both this grub and cut-worms. The chickens and birds must be asked again to help us in our warfare against this pest; the toads, salamanders, bats, frogs, and snakes must also be thanked for their help. Children must learn that life and happiness for whole communities may depend upon bright boys and girls learning to identify these pests and being able to distinguish the helpful from the harmful life about them. There may be some diseases of the white grub that we shall learn to multiply when some boy or girl tells us how. Fall plowing, so as to bring to our aid the frosts, storms and birds of winter, must not be forgotten. The white grub worm is said to be a prolific source for the spread of hog cholera, especially from buried animals.

The Chinch-bug.—The chinch-bug is, according to Professor Forbes, the worst insect pest that the farmer has to combat, especially in his small grain. The chinch-bug lives on any member of the grass family and some other plants. The chinch-bug passes the winter at the roots of tufted grasses such as timothy, under clods and stones, or among sticks, leaves and bark. From these winter quarters come, in the spring, the winged insects. The eggs are laid in April and May, and begin to hatch in May. By the last of June the old bugs are gone and by harvest time the young generation can be seen in numbers. Sometimes they appear early enough to do serious damage to the small grain. As the small grain ripens the chinch-bugs are forced from the field by their desire for green food. Corn offers the best pasture for them at this time and, if the weather be dry, they may strip a field of leaves and hence ruin the crop.

The teacher must remember that words about insects amount to very little. The child must be taught to identify and to do something to control them if he is to get the culture that the subject offers. There is hardly a farm in the mid-west where chinch-bugs cannot be found. One who is familiar with them detects their presence readily by their peculiar odor.

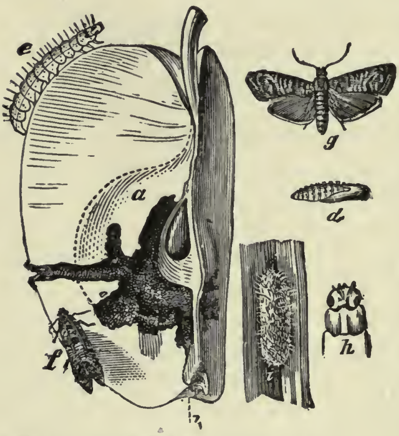
The first thing to do in gaining control of the chinch-bugs, in localities where they are doing great damage, is to destroy

by plowing under or burning all rubbish where they hibernate during the winter. Weeds along the road, or along the edges of thickets or groves, unpastured meadows, corn stalks that are not pastured off, and patches of uncultivated land bordering ponds offer excellent protection to the bugs. Some claim that wheat-growing tends to encourage the multiplication of chinch-bugs. There is no foundation for this belief beyond the fact that wheat seems to be an ideal food, is green so early and lasts until the corn is large enough for the bugs. The bugs may be kept from going to the corn by plowing a strip ten or twelve feet wide, disking the strip and then pulverizing it with a brush or pulverizer until it has a garden mulch on top. Then a furrow is made with a short log or piece of timber about ten inches in diameter. The sides of this furrow should be as dusty and as steep as possible. It may be necessary to retouch the sides in some places in order to make them steep enough to keep the chinch-bugs from climbing up. Post holes may be dug at intervals of about twenty feet. The holes should be about two feet deep and the sides vertical, as one would make with a good auger. When the holes have trapped many insects these latter may be destroyed with kerosene and the holes cleaned with the auger, or filled and new ones made. A slender line of coal-tar may be made along the bottom of the furrow or, as some prefer, along a ridge just inside the furrow, toward the corn. At first the coal-tar will soak up, but it will soon make a ridge that catches the insects if they try to cross. This may seem expensive, but it is found to cost only about twenty-five cents a day for a line one hundred rods long and the insects would injure many times that amount each day. If by accident some of the insects enter the field they will collect on the outside rows where they may be seriously dealt with by spraying the rows with kerosene and soap-suds, known as the kerosene emulsion.

INSECTS OF THE FRUIT PATCH

The Codling Moth.—The codling moth is perhaps the best subject with which to begin the study of insects unless it be in neighborhoods where apples are not grown. The presence of this insect in a child's apple which he brought for his dinner, impresses the importance of the study of insects upon him.

In the United States the codling moth causes us to sustain an annual loss of about $12,000,000. Ask the children to visit the orchard or apple pile and determine what percentage of the apples are wormy. Ask them to visit the cellar and search, especially in the barrel in which the apples were stored, for the white downy cocoons. The cocoons may also be found safely ensconced behind pieces of bark on some rough apple, plum, or cherry tree. Ask the children what they think the downy woodpecker is doing as he searches around the apple trees in winter days.



From "Our Insect Friends and Enemies" (Smith).

FIG. 104.—Codling moth and its work: *a*, the injury done; *b*, place where egg was laid; *e*, larva; *d*, pupa; *i*, cocoon; *f*, *g*, adults.

The codling-moth eggs are laid by a moth about half an inch long and so colored as to resemble closely the grayish bark on which it prefers to rest. The first batch of eggs are laid, it is now thought, on the foliage and in the blossom about the time the apples bloom, each female produces from 50 to 80 eggs, and there are supposed to be two broods each season. The larvæ hatch and feed for a time on the foliage, then gradually make their way to the little apples (Fig. 104), and, as soon as the apples lose some of their hairy surface or papillæ, begin to dig their way in. They prefer to enter at the calyx end, but may enter where an apple touches a limb, a leaf or another apple. The larvæ rapidly eat their way to the core of the apple and then feed on the pulp around the core until grown, after which they eat their way out. They crawl to some place under the bark, or drop to the ground and enter cracks, crawl under stones, clods, or leaves and there spin their cocoons. From the cocoons they emerge as the brown moths ready to lay eggs and go through the life cycle again.

The codling moths spoil our thoughts of using cider, cider vinegar, unfermented apple juice or of eating an apple. Their

presence detracts from the value of the fruit when we try to sell it. Codling moths cause a large number of apples to drop prematurely. They are a nasty, loathsome, useless pest, known and written about since the time of Cato.

The methods of control which the teacher should urge are, first, the increasing of the natural enemies of the codling moth; second, the cleaning of the old bark and trash where the insects may pupate; third, spraying. All of the woodpeckers and flickers are known to prey upon the codling moth. Professor Hodge figures that a downy woodpecker eating one codling moth a day from November to April would save, with apples at 50 cents per bushel, $585 worth of fruit each season. Another little despised helper, despised because of the ignorance of the school teachers and country school children, is the bat. Since the bat preys on the codling moth and because the codling moths fly only at night, the bat becomes during the egg-laying season our most efficient helper. As mentioned in Professor Slingerland's quotation earlier in this chapter, the codling moth has an enemy which consists of a very small four-winged fly which deposits its eggs inside the codling-moth eggs where they hatch and eat the life out of their host. There are numerous other parasites which prey upon the codling moth or act as scavengers to clean up the remains after the larvæ have been killed by enemies. There is a tachinid fly, and in Europe a number of other insect enemies. Some of these enemies have been recently introduced into California and, should they be found efficient there, will no doubt spread to other States.

In addition to the woodpeckers, the blue bird, king bird, crow, crow-blackbird, black-headed grosbeak, warbling vireo, chickadee, bush-tit and jays are known to be enemies of the codling moth. By tying pieces of bread crusts, suet, etc., on to the limbs of the apple trees, also seeing that these birds get water, we may encourage them to stay longer in the fall and to come earlier in the spring.

If we have to resort to spraying we should use Paris green or, better, arsenate of lead with the Bordeaux mixture (see Chapter XV), and spray just after the petals have fallen so as to get some of the poison inside the calyx before it closes. It may be necessary for the teacher to give a series of lessons on the parts of a flower. The names may be found in any text-book on botany, and

school economy demands that we teach them just when the pupil sees a need for them. Besides the names, a series of observations on how the flower opens and how the calyx closes will be interesting. If sprayed before the petals fall, we may poison many of the bees of the neighborhood and we must have bees if we are to grow fruit.

The Apple Maggot.—It may be the so-called worm in the apple is not the brown-headed, white, codling moth larva but instead the larva of the apple maggot. This larva comes from an egg laid by an insect which much resembles a house fly. The apple maggot fly is somewhat smaller than the house fly and has a peculiar figure on the wing which some think looks somewhat like a turkey. It appears that this pest is to become second to the codling moth in injuring the apple crop. Each female lays from 300 to 400 eggs and thus may destroy one or two bushels of apples. The eggs are deposited inside the pulp of the apple and soon hatch. The larva then begins to bore its way through and back and forth in the apple. The apple falls and the larva emerges, goes into the ground and there pupates. In Maine, elaborate experiments have been made in order to discover the best means of controlling this pest. They found that the flies may be easily caught on the foliage, but this means hand picking. A more effective and cheaper method seemed to be the gathering of every windfall, or the pasturing of the orchard during the early part of the season with pigs or older hogs, well rung, which eat the windfalls. Close attention must be given to decaying apples and stored apples lest they become a source of spreading the pest. The refuse from stores and the remains of apples which we buy when our crop is short may infest a whole neighborhood with both the apple maggot and the codling moth. The Rhode Island Station came to the conclusion that frequent cultivation in the early part of the season helps some in controlling the maggot. But in that case birds and poultry must be asked to assist us. Nothing is known of the natural enemies of the apple maggot beyond the fact that nearly all birds prey upon both the larvæ and the insects.

The Curculio.—Another insect very injurious to apples and cherries, but preferring plums, is the curculio. Her presence is indicated by the crescent-shaped cut with the dot inside which she cuts and punctures. She makes the crescent-shaped cut, that

looks like an ugly girl's mouth, in order to give the larva air, and she punctures the little dot or pin-head hole in order to deposit her eggs inside the plum, apple or cherry. Inside the fruit the larva hatches and then eats its way to the centre. This causes the fruit to fall prematurely and then the larva emerges and pupates in the ground from one to four inches deep. From the ground it emerges again the same fall as a brown beetle. It passes the winter under bark, in cracks and buildings and then comes forth in spring to destroy from 100 to 200 pieces of fruit. Children should be taught that the first thing to do in order to keep the plums from being wormy is to pick up and destroy, by feeding to the pigs or by burning, every piece of fruit that falls before it is ripe. A sheet may be spread under the plum tree to catch the adult curculios which may be jarred into it by striking the tree with a heavy club with a piece of cloth around one end so as to prevent injury to the bark. The curculios "play 'possum" and double up as though dead, for some minutes. From the sheet they may be emptied into a pail and then burned. Thorough cultivation and the presence of chickens do much to keep the curculio in check. In fact, for most of the year, the plum orchard and the chicken yard should be one and the same yard.

Other Insects.—There are many other insects the presence of any one of which may make it necessary for the teacher to send to her Experiment Station for information and for her to give a series of observation periods and lessons on life, habits, and most approved methods of controlling that particular insect. There are leaf-curlers and folders for several kinds of trees. Melons, cabbage, strawberries and other plants invite their particular enemies. There are a number of insects which have the pernicious habit of eating just under the bark of trees. These are called borers. Some of them prefer peach trees and hence are called peach borers; others are apple borers, grapevine borers, currant borers; some have flat heads and are called flat-head borers; others have pointed or round heads and take their names after the shape of their heads.

Some insects make spider-web-like tents in the twigs of trees and are called tent caterpillars. Often they have to be destroyed with a torch but sometimes their nests may be cut off and taken to the house, and burned. If "a penny saved is a

penny earned," and if "a stitch in time saves nine," then an insect destroyed is a tree saved, and an insect destroyed in the fore part of the season may be better than a hundred destroyed later.

There is another class of insects which the ordinary observer calls *scales,* hence the name San José scale, cottony cushion scale, oyster shell scale, etc. The neglect of the San José scale may mean the quick eradication of the fruit industry of a whole community. A bright-eyed teacher may often, by detecting the presence of one of these pests, save to the community more than her wages for years. Not all will appreciate her good work but, as Shakespeare says, "There be one or two whose good opinion outweighs the hundred," and the consciousness that one has done his duty is often compensation enough.

The Beneficial Insects.—A series of lessons should certainly be given on the beneficial insects: Bees, wasps, lady-beetles, ichneumon-flies of which there are many species, syrphus and tachina-flies, chalcis-flies, braconids, damsel-flies, dragon-flies, ant-lion, tiger and bombardier-beetles should all be recognized and their presence encouraged by farmers. Nor should we neglect those that are beautiful but neither harmful nor beneficial beyond giving us pleasure by their beautiful form and graceful movements. Among these are some of the butterflies, cecropia, promethea, etc.

Bees in the Country.—Bee-keeping is an old, old industry and yet the knowledge of how to keep bees in a modern hive and care for them in modern ways is of very recent origin. Bees are very necessary for the man who would succeed with fruit. Poorly pollinated fruit is frequently misshapen fruit. Teachers should see that each pupil who graduates from a country school, whether graded or ungraded, is familiar with the parts and functions of a bee-keeper's equipment. Hive, body, super, frame, section, smoker, veil, gloves, excluder, queen trap, brooders, and other apparatus should be taken to the school-room and lessons on how to use and how to keep them clean and free from bee diseases should be given.

The life history, the kinds of bees in a hive, the functions of each, and how best to care for and breed desirable ones should be discussed. One or two bee booklets should be made by children who come from homes where bees are kept. Some of the pupils

should be led to take bee-keeping for their home project. It is not intended that these home projects shall be followed necessarily as a life work. It is the aim to teach children to do some things and to do them well. The boy is more of a boy when he has become complete master of a home project.

The kind of bees—with emphasis on the *kind*—that has been found best for the locality should be taught. The sources of honey, honey as food, and how to keep and market it should also be taught. Where to locate the apiary, and how to keep it free from the deadly bee diseases are well worth learning.

Spraying.—Man has not been able to control insects altogether by good farm practices and by coaxing the birds to help him. There are times when he must poison or spray or poison by spraying. For the purpose of knowing what to do to rid places of insects by using chemicals, we classify the insects into biting

From "Our Insect Friends and Enemies" (Smith).

FIG. 105.—Grasshoppers make splendid poultry food.

and sucking. Biting insects may be poisoned by some form of arsenic. Sucking insects must be smothered by some oil preparation, kerosene emulsion, tobacco-soap emulsion, whale oil emulsion or some similar preparation.

Among the biting insects are the Colorado potato beetle, commonly called the potato bug, the army worm, the cut-worm, the cabbage worm, the currant worm, the tobacco worm, and the many different bill bugs. Among the sucking insects are the mosquitoes, the plant lice, and the San José scale.

For killing biting insects we use Paris green, white arsenate of lead, or some prepared spray mixture. The spray formulæ are given in Chapter XV. Some scale insects require a spray so strong that it would kill foliage and hence we spray for those insects during the winter and spring months before the leaves appear. For this we use some form of the lime sulphur mixture, formula for which is also given in Chapter XV.

QUESTIONS AND STUDIES

What can you learn about:

1. Insects for nature study lessons?
2. Nature's balance?
3. Farm practices to keep down insects?
4. Household insects?
5. Field insects?
6. Orchard insects?

What can you learn about:

7. What the farmers use for spraying?
8. When and how they spray?
9. What they consider the most troublesome insects?
10. What farm practices are followed to control insects in your district?

References.—Smith, Our Insect Enemies and Friends; also Economic Entomology; Saunders, Insects Injurious to Fruits; Davis, Productive Farming; other texts on agriculture; Cyclopedia of Agriculture; Farmers' Bulletins No. 45, Some Insects Injurious to Stored Grain; No. 99, Three Insect Enemies of Shade Trees; No. 127, Important Insecticides; No. 453, The Gypsy Moth; No. 444, Remedies and Preventatives against Mosquitoes; No. 447, Bees; No. 503, Comb Honey; U. S. Bureau of Entomology Circular No. 71, House Flies; Bulletin No. 198, Ohio Experiment Station, Spring Manual of Economic Zoology; the same No. 233, Fall Manual of Economic Zoology; Kansas Bulletin, Vol. I, No. 3, A Study of Insects; Ohio Station Bulletin No. 160, The Codling Moth; Illinois Experiment Station Bulletins No. 104, Insects Injurious to Corn; No. 114, Spraying for Codling Moth; No. 116, White Grubs and May-beetles; No. 130, The Corn Aphis; No. 151, Insects of Shade Trees and Shrubs; Your Experiment Station Bulletins.

Courtesy Country Life in America.

FIG. 106.— Cecropia moth.

Our modern word hygiene comes from "Hygiena," the Greek goddess who guarded the health of the people. In our modern civilization she has become the greatest of all the gods.—BREWER, in "Rural Hygiene."

The word "hygiene" is practically synonymous with cleanliness. . . . The essentials of hygiene may be summed up in . . . clean housing, clean feeding, clean yards and runs, and clean animals.—LEWIS, in "Productive Poultry Husbandry."

To the student, the fungous diseases of trees form an extremely interesting group of organisms, one that he likes to examine and study. To the orchard owner they are a pestiferous collection of annoying troubles against which he must constantly be on his guard. But even with the practical orchard man it is very desirable that he should give them sufficient study to know what methods are best and why they are best. It has always seemed that almost any one ought to do better work if he knew why.—SEARS, in "Productive Orcharding."

Life in the country has been rendered less simple. . . . A whole series of new problems has arisen. . . . The bacteria concerned in industrial processes have received a not inconsiderable share of attention and have fully repaid it. The canning industries, the brewing industries, the manufacture of wine, cider, and vinegar, the fermentation of tobacco, the retting of flax, the tanning of leather, the pickling of vegetable substances and of fish, and, above all, the treatment of milk and its products, have been benefited by the study of bacterial friends and foes.—LIPMAN, in "Bacteria in Relation to Country Life."

CHAPTER XI

PLANT AND ANIMAL DISEASES

The Microscope Reveals a Wonderful World.—The world seen by the naked eye is beautiful and wonderfully varied; but there is another world equally beautiful and varied, a world that means life or death, success or failure; a world so subtle and complex that the most learned scientists make no claim to more than a partial understanding of it. And yet what a blessing is that little which they have learned. Plagues, diphtheria, blights, tuberculosis, smuts and kindred phenomena are not now looked upon as dread visitations of a wrathful God. We are slowly but surely beginning to obey that first command—"Have dominion over them." Diseases of plants and animals are coming under man's control. He is slowly learning that potato blight, grain rust, hog cholera, black-leg, soil bacteria, etc., are as much under his control as are water and weeds. Is it right that the country boys and girls, whose very existence depends upon a rational control of this wonderful bacterial and fungous world, shall grow up unconvinced of the existence of these bacteria and fungi because unable to see through a microscope? Is it right that a farmer be doomed to toil for years to no advantage because his teacher and his school failed to bring his mind into contact with this wonderfully interesting world? The great corporations have skilled experts to study processes and to give their managers and workmen the results of that study, so that they may employ only the most approved methods of dealing with the bacteria encountered in making canned products, leather, tobacco, wine, beer, pickles, and hundreds of other things known to modern commerce. The farmer, too, has his skilled experts in the State, the United States Department of Agriculture, and in the Experiment Stations. But to what purpose do these toilers labor if our schools fail to bring the mind into contact with these phenomena which influence life on every side? Bulletins by the thousands are published at our expense and distributed free, but many of the most valuable ones cannot be read by one who has not had an introductory course in bacteria and fungi.

Teach by Use of Types.—Psychology teaches us that we do not need to study everything, but by becoming conscious of the typical from actual observation, or better, by care and culture, we may reason fairly well about other things. A child cannot learn in the public schools all moulds and bacteria, but he should learn something about typical ones. Our schools have no right to let pupils graduate who doubt the existence of disease germs. To see is to believe, therefore let them see.

Mildews and Moulds for Nature Study.—Probably one of the mildews or one of the moulds makes the best introduction to the study of the fungi. Let some child draw a tooth-pick or sliver over a piece of mouldy bread or fruit and then rub the tooth-pick across a piece of fresh moist bread. The tooth-pick should be drawn over the fresh piece so as to make a letter X or the child's initials. Then lay the piece of inoculated bread where it will keep moist and out of sunlight—under an inverted box, containing moist blotting paper, or a saucer with a little water in it will do very well. Remove the cover after two days and later observe from day to day what happens. Why do we have to keep it out of sunlight? What does this suggest as to the control of diseases?

Professor Hodge recommends the following: "A jelly glass, or even a medicine vial, furnishes ample room for a garden of these instructive plants, and they can be cultivated on almost anything for soil. First we will take some kind of liquid culture medium, in which we can see all of the different parts of the plant as it grows. Fruit juice as it comes from preserves, as clear and as colorless as possible, diluted one-half and filtered or strained through fine cheese cloth, makes an ideal medium. Fill the glass or vial half full and sprinkle a little dust from the school-room over the surface. Cover and set aside to observe from day to day. Three such cultures should be made, one of which should be kept in a dark place, one in a room where direct sunlight does not fall upon it, and the third should be kept in the sunlight as much as possible." If the teacher thinks best, each pupil may have a vial and make his own culture, taking notes of just what he does and what results. Then questions may be asked to bring out why in canning we heat things to destroy spores and germs, and how we put on covers, etc.

Study the Downy Mildews.—If the season is wet and warm

enough, a study should be made of one of the downy mildews. These attack a large variety of plants, such as lilac, grape, cucumbers, onions, beans, potato, peach, plum and other plants. The grape (see text in Botany for *Plasmopara viticola*), or the lilac (see Botany for *Microsphaera alni*) leaves are apt to be covered on the under side. The body part of the fungus called *hypha* is a thread or mass of threads winding its way around, through and among the cells of the leaves. Most of the hyphæ grow between the cells of the leaf and send into the cells small bodies called *haustoria*. These haustoria suck the life from the leaf cell, to feed the hyphæ of the mildew. These fungi do not have seeds but they produce little microscopic bodies generally spherical in form, which spread the plant from leaf to leaf. Somewhat similar spore-bearing bodies may be seen on the common bread mould. But the downy mildews produce their spores at the end of stalks which emerge from the breathing pores (stoma) on the under side of the leaves or else in little sacks which are pushed out through the tissue of the leaf. The little spores go off into the air like sparks from a Roman candle. The spores fall upon other leaves and there germinate and give rise to new hyphæ.

The only way man can protect his plants is to have the leaves well covered with a very thin coat of Bordeaux mixture or lime-sulphur solution. This must be spread with a spray so as to be very finely divided and a thin film spread over the whole surface. There is no way to help a leaf once the hyphæ have entered and are growing within the tissue.

Rusts—Wheat Rust.—Now by analogy we should be able to make plain the spread of the rusts. First of all, while some farmers may not believe it, the boys must be impressed with the fact that rusts are plants, that plants come from plants, that as the Good Book says, "Whatsoever a man soweth that shall he also reap." There are many rusts and it is a question whether each grows on more than one kind of plant or not. There are oat, wheat, bean, clover, timothy, stone fruit rusts and others. Wheat rust (see Botany for *Puccinia graminis*) is common and makes a good type study. Wheat rust exists in three forms, though it is believed that two forms on the wheat alone are sufficient to perpetuate the disease. During one stage the fungus lives on the leaves of the barberry. It emerges from the under

side of the barberry leaf as a red rust; that is, the spore-bearing bodies, instead of being white as we found them in the downy mildews, are red. From the barberry leaf the spores are wafted in the wind to the wheat, where they grow and cause blister-like bodies which break open and from which emerge either of two kinds of spore stalks. Some (the *uredospores*) are red; the others (*teleutospores* or winter spores) are black.

No satisfactory method for controlling this disease has been found. Part of the summer spores may be destroyed by burning the straw and part of the winter spores may be destroyed by burning the stubble, but by that method we lose the plant food and humus. Rotation of crops is of aid and favorable weather helps very much. This means rather cool, dry weather, for hot, wet weather is the most favorable weather for the rust. Wide rotation of crops helps but the spores are blown for miles in some seasons. The fallowing practised with the dry farming is beneficial both to preserve moisture and to help hold the rust in check. Macaroni wheat is not injured so seriously as are other varieties, and hence we may be able to breed a hybrid of the macaroni and some of our common wheats which will be immune to the rust.

At times it is necessary for a farmer to stop growing certain kinds of plants for a series of years in order to free a place of some of the rusts.

The Potato Blights.—Other fungous diseases somewhat like the rusts are the potato blights. These cost the people of the United States millions of dollars each year. There are two potato blights, the early and the late. The early blight (see botany for *Alternaria solani*) attacks the leaves and stems only. The late blight attacks both stems and the tubers, giving us the black potato rot. The early blight may so weaken the plants that they fall an easy prey to the late blight. The early blight affords a place where a child may do some missionary work as he goes to and from school. The farmer is busy, very busy. If he spent his time watching his potato plants, he would get little else done. The early blight comes " like a thief in the night." Sometimes in a very few days a field is blighted beyond recovery. Suppose a teacher were to lead her pupils to be on the look-out. The blight appears as grayish-brown spots on the leaves. The brown spots soon become hard, the leaves and stems turn yellow

and later brown (Fig. 107). Some farmers who do not understand the blight, think that their potatoes have ripened prematurely. But they have had the life eaten out of them by the hyphæ of the fungus. Nothing can be done to kill the blight once it has entered a leaf, but if there is Bordeaux mixture on the leaves, when the spore lights the mixture kills the spore as it germinates. Again we may accomplish much by breeding for a blight-resistant potato (see tuber-unit planting and Fig. 23, Chapter II).

Fig. 107.—Potato tops. Difference in size is due to difference in power to resist early blight.

The Late Blight.—Later in the season the potato tops may be attacked by the other and even more serious disease, the late blight (*Phytopthora infestans*), which, as stated above, injures both stems and tubers. This late blight gives us the black rot, which may cause serious trouble after the potatoes are in winter quarters. This late blight offers an interesting illustration of how dependent farmers are on the weather. This blight does not develop enough to do serious injury except when the temperature is between 72° and 74° F. If the temperature rises or falls much below 72° to 74°, it checks the growth of the disease. The blight appears as brownish or black spots that soon become soft and foul smelling. The disease spreads rapidly over the leaves and down the stems where it enters some of the tubers. The tubers affected become black, soft, nasty, ill-smelling, " rotten potatoes." So suddenly does the disease appear and so rapidly does it spread that a healthy field may in

less than a week appear as though a fire had swept over it. In 1845 the disease caused the terrible famine in Ireland and in parts of Europe and the United States.

At times like that, when a teacher has saved to some poor family its food supply, she feels that life is worth living and teaching worth while. Children should be taught to be alert for the signs of the coming of the blight. The farmer should have spray machinery in order and materials on hand with which to make the Bordeaux mixture.

FIG. 108.—Oat smut on left, sound oats on right.

Potato Scab.—This is another fungous disease which is very destructive. We know its signs by the eaten surfaces of the tubers. The disease lives on the tubers and is planted with them. It lives over winter in the soil and may do injury if the field is planted to potatoes more than one year at a time or if the adjoining field is planted to potatoes and machinery drags soil particles from one part to another or one field to the other. Before cutting the tubers for planting they may be soaked for an hour to an hour and a half in a 1 to 32 solution of formaldehyde. This is made by adding 1 pound of formaldehyde to 32 gallons of water. The formaline may be poured into a barrel, the potatoes put into a gunny sack and immersed in the liquid, then removed, allowed to dry and cut for seed.

The Grain Smuts.—Grain smuts (Fig. 108) are another kind of disease easily controlled on some of the grains. Seed oats may be sprayed, or when one has only a small amount of seed it may be treated by a twenty minutes' immersion in a 1 pound to 40 solution of formaldehyde. If sprayed, about 8 inches of oats should be shovelled into a wagon box, levelled and then thoroughly sprinkled with a 1 to 30 or 40 solution of formalde-

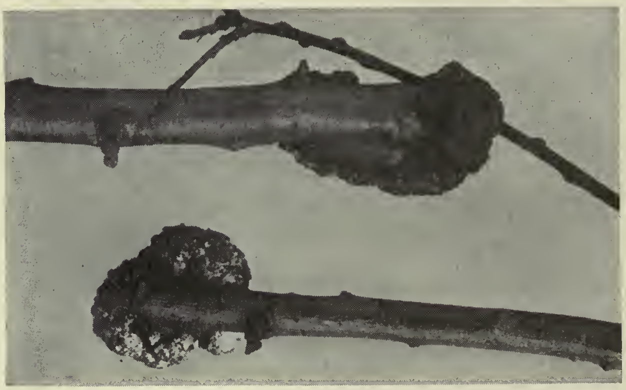
hyde and water. Another 8 inches may be shovelled on to the first 8 inches and sprayed and another 8 inches and sprayed. Then all should be covered with horse blankets, sacks or old pieces of carpet and left to fumigate for ten or twelve hours. Then the oats should be shovelled out on to a floor where they may be stirred frequently and thoroughly dried. The oats may be sown directly from the fumigation, if due allowance can be made for their being swollen and if one has a force seeder that will sow damp grain. It is claimed that from $30,000,000 to $40,000,000 are saved to the people of the United States each year from the discovery of this treatment alone. Evidently if "Agriculture is the hope of the nation, the hope of agriculture is applied science."

About harvest time, if the school be in session, the teacher may impress upon the pupils the necessity for this work by having them go to the field and mark off two square feet, or throw a barrel hoop over into the field and then count the number of grain stalks in the square or hoop, and then find the fraction or percentage that is destroyed by smut. Figure the loss per acre. The seed for 10 acres can be treated in four hours or less. What is the income per hour for treating seed? The seed oats need not be injured in any way if the formaline fumigating is properly done.

Bacteria.—Other plant and animal diseases are due to bacteria. These are the smallest known plants. Most botanists prefer to classify the bacteria as a separate kind of plants from the fungi. The President of the American Medical Association suggests that we classify the bacteria as below both plants and animals. Medical doctors are very generally coming to the conclusion that most animal diseases are due to bacteria. Bacteria are so numerous and so varied that the study of them has given us a new science called *Bacteriology*. These organisms are microscopic and multiply by division of the parent cell, some of them multiplying as frequently as once every twenty minutes, at which rate a single parent would give rise to over 280,000,000,000 in a day. Many of these bacteria are beneficial in the extreme. Probably no decay can take place without bacteria. Think of what this would mean if every dead plant and animal of the past were lying on the surface of the earth to-day. We could not pass around, over and among them. Our soil could

not get nitrates from the humus to feed new plants. We would have no plants to gather nitrogen from the air (Fig. 77). The bacteria also cause many familiar phenomena of the farm. They cause the disagreeable odors which warn us of danger. The bacteria in milk cause it to turn sour, bitter, or to take on the desirable flavors of butter and cheese.

While there are many beneficial bacteria, there are also many destructive bacteria which sometimes begin the disintegration of the tissues of living plants and animals. Diphtheria, fevers, and some blights are among these destructive bacteria. It is now believed that the injury to plants and animals comes partly from the weakening of the tissues, but mostly from poisons called toxines which the bacteria give off.



From "Productive Orcharding" (Sears).

Fig. 109.—Black knot of the plum.

The Fire Blight.—One of the most destructive of the plant diseases is fire blight, which attacks apple and pear trees. The bacteria live in the cambium layer just under the bark. They kill the stem and thus cause the bark to become rough, withered and dark; the leaves turn yellow and then brown. The pith turns mealy and bright yellow. We say "the tree is dying at the top." The disease may be eradicated by cutting off the diseased limbs about a foot below the affected bark and then burning the limbs, leaves and all. If neglected, the disease will spread down the tree and then to other trees, and thus in a very few years destroy a whole orchard. If one cuts off more than one limb, the knife

blade should be wiped or dipped in kerosene or carbolic acid to prevent its introducing the disease into fresh wood. Let the teacher send the children home to search for fire blight. From the discussion at the school much valuable information may be disseminated throughout the neighborhood.

The Black-knot.—Black-knot is a disease of plum and cherry trees (Fig. 109). Its presence is indicated by the peculiar knarled knots on the limbs. Like fire blight of apple and pear trees, the black-knot must be cut out and burned or it will injure all the trees of the orchard and neighborhood. Nursery stock should be inspected very carefully for these diseases and rejected upon detection of the slightest symptoms. Teachers should help to mould a healthy public opinion, to coöperate with their Experiment Stations and Agricultural Departments for the efficient enforcement of laws against the spread of such diseases.

The Club Root.—A disease attacking truck crops is the club root of cabbage, turnips, cauliflower, etc. Heavy liming of the soil, and wide rotation of crops so that these crops do not come on infested soil for some years, are the remedies.

Peach Curl.—Peach curl can be controlled by spraying with Bordeaux mixture. It is estimated that this single disease damages $3,000,000 worth of fruit each season.

Cotton and tobacco wilts destroy the plants completely and stay in the soil for years. The breeding and planting of resistant varieties seem to be the remedies.

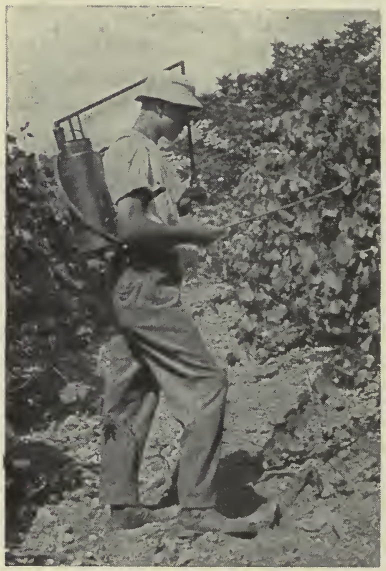
Brown Rot.—Fruit mould, or brown rot, is a serious disease of many of the different kinds of fruit. It attacks the fruit on the tree. The fruit shrinks, dries up, grows black and drops or clings persistently to the tree. The disease may be controlled by gathering and burning diseased fruit as soon as it appears and the next season spraying with Bordeaux mixture or as directed by the Experiment Station spray calendars.

Peach Yellows.—Peach yellows is probably a bacterial disease; but as near as I can learn the "peach yellows" germs, like the smallpox germs, if there be such, have not been separated, identified, or grown in pure cultures. The peach yellows must be controlled by growing resistant varieties, not planting the seeds of affected fruit, and the eradication by burning of affected trees.

Chestnut Tree Blight.—This terrible scourge, introduced probably from Japan, has already done some $30,000,000 of

damage. The teacher should get copies of the special reports of her State Commission or Experiment Station, and if in a State where chestnuts are grown have a special lesson, or part of her Arbor Day program on the chestnut tree blight. Breeding resistant trees and eradication of infested trees seem now to be the only remedies.

Spraying.—The principles underlying the farm operation called spraying should be thoroughly understood (Figs. 110–114). We wish to keep the mind of the farm boy open and yet we hope to give him knowledge enough to protect him from many kinds of fraud imposed on the people by the patent medicine quacks. If the pith or cambium layer of a plant is the seat of the disease, it is hard to see how anything can be done more than to cut the plant off well down to unaffected tissue, cut it off with sterilized knife or saw and burn the affected part. If the disease attacks the surface, if one wishes to prevent the entrance of the spores, or if one wishes to check the spread of a disease which lives on the surface, there is a use for spraying. The Bordeaux mixture or the lime-sulfur mixture, formulæ for which are given in Chapter XV, is used. The lime-sulfur is probably the more effective, but there is less danger of injuring the foliage by using the Bordeaux mixture. But farm folk must be taught to keep a constant watch for the appearance of the diseases and then remove the diseased parts as soon as possible, or if it be a disease easily held in check by spraying, spray at once upon noticing the appearance of the disease. "Eternal vigilance is the price of peace."



From "Productive Orcharding" (Sears).

FIG. 110.—Knapsack sprayer. This is an excellent pump for rough ground or wherever it is difficult to get about, but is rather heavy when one has much spraying to do.

From "Productive Orcharding" (Sears).
FIG. 111.—Gas power sprayer. An excellent type in some respects, but it is too difficult to clean out the tank.

Courtesy Osborn Co.
FIG. 112.—A four-row potato spray.

Animal Diseases: Tuberculosis.—Bacteria cause a number of very destructive animal diseases among which is the great "white plague" that is now killing more people in the United

States than any other known destructive agency. Specialists are not yet agreed as to whether cattle tuberculosis is the same thing as that which affects people, or as to whether one is the cause of, or can be contracted from the other. The evidence seems to be very much in favor of the view that bovine tuberculosis may be the cause of human tuberculosis or consumption. The bacteria of this disease may attack any organ of the body. Thus a cow may have tuberculosis of the jaw, brain, kidneys, muscles, intestines, udder, or other parts. It is claimed by the Bureau of Animal Industry that it is impossible to detect the germs in the milk of affected cows where there is absolute cleanliness in the milking and where there is no tuberculosis of the udder or milk glands. But it is practically impossible to be clean when milking. It should, however, be made clear to the boys and girls that danger is reduced just in proportion as the place where the cow stands, the udder of the cow at milking time, the pail and other utensils, the hands and clothing of the milker and the air of the places where the milking is done and the milk is stored, are kept clean.

Courtesy Osborn Co.

Fig. 113.—A knapsack spray.

The symptoms of tuberculosis are not easily detected until the case is well developed. In both farm animals and human beings, a gradual loss of flesh without any apparent cause is apt to be the first symptom. This means, in case of the farm animals, that the farmer wastes his feed on animals that grow lighter all the time while often increasing the amount of feed consumed. In case of the cow, an irregular milk flow is sus-


Courtesy Osborn Co.

Fig. 114.—Applying the dust spray.

picious, a tendency for the hair to stand on end and look dry, a cough when the animal rises or starts quickly, especially on cold days, a humped position when standing and a general lack of life and vitality are all indications that the disease may be present. But the tuberculin treatment is the most reliable test. Post-mortem examinations reveal the fact that practically every animal that reacts to the test has tuberculosis. There is no known remedy for farm animals; they are kept at a loss and hence should be gotten rid of as soon as possible. In the case of human beings there are many who recover. Where the disease is feared, a specialist should be consulted at once.

Tuberculosis a House Disease.—Tuberculosis is a house or barn disease. Think of it, out on the wide, wide prairies, the most prevalent diseases are caused by the lack of fresh air. The rule says, "A cubic foot of air for each pound of animal, with rather more than less for human beings and horses." A cubic foot to a pound applies only where there is good ventilation, that is, where the air comes into the stable or house through many small openings instead of through large openings which allow draughts and which give too much air to the animals next to the sides and too little to those nearer the centre of the building. Dairy cows are generally thin and hence must be protected from the biting blasts of cold winter days.

School-houses may become veritable breeding places for all the worst contagious diseases. If a school building is well ventilated, that is, so that the air is all changed as often as once each half-hour, each child requires, if the ceiling be ten feet high, a space at least three by four feet. Many of our country schools are too small and our teachers should help to mould public opinion in favor of better and larger buildings. It is practically impossible to change the air of a school building every half-hour and keep the room at a comfortable temperature, and therefore the only safe way is to mark the building off into strips six feet wide and then give each child a seating space of at least three feet. Small diverting boards placed under the window sash permit the air to come into the room in an upward current. This is a splendid method of ventilating a school-house unless the air fall heavily on the heads of some of the pupils near the opposite side of the room. Cheese cloth, about fifteen inches wide and as long as the window is wide, may be tacked to the window sash, preferably the upper, and then to the casing so that the sash may be

raised and lowered freely. When the sash is lowered, it stretches the cloth which covers the opening in the window. This cloth allows air to pass in or out quite readily but prevents draughts on the children's heads.

Other Animal Diseases.—There are many animal diseases the presence of any one of which in a district may make it advisable to give a series of lessons and have one or two booklets made on that disease, giving the symptoms, treatment, etc. There is a very close resemblance between the diseases of animals and the diseases of human beings. For example, practically all of the young stock which I have lost in recent years have died from pneumonia. This dread disease comes to colts, cattle, hogs, children, or to men and women most readily after the body is weakened from some other ailment. Hogs die not so much from cholera alone (Fig. 115) but the cholera weakens them so

A *B*

FIG. 115.—*A*, This hog had serum-virus treatment; *B*, This one had cholera.

that the pneumonia kills them. It is the belief of most well-informed people that we carry the germs of disease with us much of the time, but if the body is clean, well rested, has proper food and plenty of fresh air, the scavengers of the body easily hold the disease germs in check. But if we over-eat, or if we eat improper food, the disease germs get the start of the scavengers. Now green corn and hog cholera may be explained on the ground that, with a hog at normal temperature, the cholera germs are not apt to get the start, but if the hog is fed on green corn and the temperature of its body is kept a few degrees above normal for several days, the germs become so numerous that the protective agencies of the normal animal cannot cope with them.

Science seems to have given us an almost sure preventative for some diseases. Among these are typhoid fever, smallpox, and hog cholera. For cholera the serum-virus treatment is used

successfully, and, where carefully administered before the hogs are seriously infected, seems to be a very reliable means of immunizing hogs. In most cases it is best to use the treatment when cholera is known to be in the neighborhood. In cases where the serum is administered after the hogs of a farmer are known to be diseased, only about 60 per cent seem to be saved, while, if administered before a herd is infected, as high as 100 per cent have been saved (Fig. 115).

Information in the Goverment Bulletins.—The National Department of Agriculture and the State Experiment Stations send out splendid literature on nearly all the diseases of the different farm animals. The library of the redirected school should be the place where the farmers can go to learn the very best and the very latest that is to be had on the diseases of both their plants and their animals. The boys and girls of the new school must learn that modern sanitation is a study of great interest and of practical value; that civics and health are more closely related than we have thought possible in the past. The new farmer should learn that physics, chemistry, botany, zoology and some bacteriology are necessary to enable one to intelligently care for farm animals. While these studies may need redirecting, yet they are the foundation studies for a clear understanding of plant and animal diseases. He who starts life as a farmer without them starts greatly handicapped.

QUESTIONS AND STUDIES

What have you learned about:

1. The farmer's dependence upon the microscope?
2. Mildews and moulds?
3. Rusts?
4. Bacterial diseases of plants?
5. Animal diseases?

What can you learn about:

6. The most injurious fungus diseases in your locality?
7. The most injurious bacterial diseases?
8. What your State is doing to clear it of the "white plague"?
9. The food laws so far as they aim to protect the consumer from diseases?
10. What protection the farmer has against the importation of diseased plants and animals?

References.—Text-books in Agriculture; Duggar, Fungous Diseases of Plants; Stevens and Hall, Diseases of Economic Plants; Ward, Timber and Some of Its Diseases; Burkett, The Farmer's Veterinarian; Farmers' Bulletins No. 91, Potato Diseases; No. 206, Milk Fever; No. 507, Smuts of Wheat, Oats, and Corn; Ohio Experiment Station Bulletin No. 214, Diseases of Cultivated Plants; Farmers' Bulletin No. 530, Important Poultry Diseases; Bailey, Cyclopedia of Agriculture.

Good tilth brings seeds
Ill tilture, weeds.
—Tupper.

Astonished at the performance of the English plow, the Hindoos painted it, set it up, and worshipped it; thus turning a tool into an idol.—Spencer.

A weed has been defined as a plant out of place. . . . We may define "weed" by saying that it is a plant injurious to agriculture and horticulture. . . . Weeds are of tremendous economic importance. . . . Weeds are injurious to farmers because they exhaust the soil. . . . Another reason why weeds are injurious to young crops is because they crowd out the useful plants. . . . Weeds are injurious because, on account of their presence, it is much harder to remove the crop. . . . Weeds are frequently injurious because they harbor fungi. . . . Some weeds are injurious because they are poisonous. . . . Certain weeds are injurious because, when they become mixed with small grain, they must be removed before it can be sold.

Some weeds are useful. . . . Digitalis is obtained from foxglove; hyoscyamine from black henbane; daturin from Jimson weed. Many weeds like tansy and hemp have medicinal properties. Others serve culinary purposes, as when the roots of chicory are used as a substitute for coffee. Lamb's quarter, dandelion and the young shoots of pokeweed are used as spring greens. The roots of tanweed were formerly used in the process of tanning. The tubers of artichoke are used as food. . . . Sweet clover is an excellent bee plant, a good forage plant and a satisfactory soil renovator. . . . Professor Bolley says, "The plant growths, consisting largely of common weeds and grasses which at once occupy idle land, keep it from becoming a useless dust bed and finally a mass of shifting sand."—Pammel in "Weeds of the Farm and Garden."

CHAPTER XII

WEEDS PLANT ENEMIES

Weed Study in Nature Study.—If a child has had a good course in nature study, such as that outlined by Schmucker in his book, "The Study of Nature," or by Hodge in "Nature Study and Life," before he begins the study of agriculture the child has learned of some five or ten plants each year, for five or six years. This nature study work should have implanted in the child a love for the wild flowers and it should have taught him some things to do to help preserve them. His nature study should have taught him to know five or ten poisonous plants and how they poison. His school garden work has taught him how to grow many of the cultivated flowers and vegetables.

When the child comes to the study of agriculture in the seventh and eighth grades or, better, in the high school, he should learn to identify ten to twenty of the common and troublesome weeds. He should learn to know them from seed, leaf, stem, or sprouting seedling. This he may have learned in his nature study. After one has learned to identify a weed, he is ready for what should be the first step in agriculture, namely, to learn how to control or eradicate it in the most economical and efficient way.

Weed Booklets.—Some of the members of the class, if not all, should make a booklet on weeds. They should learn that the sources of information for a topic in agriculture are the same as the sources of information for any topic that one may have to write upon. Our sources of information may be classified under four heads, and pupils should use each of them. They are: First, observation; second, conversation with well-informed people; third, reading; and fourth, meditation. The well-informed people should include the best farmers of the district and the men at the Experiment Stations and the National Department of Agriculture. He may, however, have to be content to learn from this latter class by reading their bulletins and books. The point I wish to make is that the learning of reliable sources of information and how to tell which are reliable, is just as valuable as the learning of some fact in agriculture. The old adage tells

us: "The next best thing to knowing a thing is to know where to find out about it." By the time the child becomes a farmer there may have been discovered better ways than the ones we are now teaching, hence he needs to know where to get the best that there is to be learned on the different subjects.

In his study of plant diseases the student learned of plants that are man's enemies. Most of these are microscopic plants. There remain to be studied a large class of plants against which man has fought for ages. During this fight, by the law of the "survival of the fittest," these plants have inherited the tendency to come up where man least expects them, to come up at times when he cannot get at them, to survive after his hoe or cultivator has passed over them, and to multiply in incredible numbers so as to insure the survival of some of the species. Most of these plants were brought to America from Europe. Man has fought them, and will have to fight them, through human history.

Benefits from Weeds.—As in most things there is some good so there is in weeds. Weeds may add humus to the soil, though it may be humus that is poison to the cultivated crops. Weeds have compelled man to cultivate the soil and thus have the benefit of tillage. Many of the weeds help in preventing erosion, and some of them help to beautify the landscape by covering the scars made by wheel and pick and hoof. Many weeds furnish valuable drugs and medicines.

Definitions of Weeds.—Some one has said that a weed is a plant growing where a man does not want it; in this sense extra corn plants in a field are weeds. The farmer generally thinks of weeds as plants which his stock do not use and which grow in spite of his efforts to rid his place of them. The term *weeds* is not applied to bacteria and fungi but is used for the higher plants only. In this sense a weed is a plant able to take care of itself under any and all conditions.

What Farmers Lose by Weeds.—It is estimated that the farmers of the United States lose each year somewhat over \$100,000,000 from weeds. Professor Pammel, in his recent book on "Weeds on the Farm and Garden," says that the farmers of the single State of Iowa lose between \$7,000,000 and \$9,000,000 each year on weeds alone.

Weeds injure a field in any one or more of a number of ways: The weeds may use the available plant food of which there may

be but little at any one time; in this way weeds will prevent a tenant from getting what he pays rent for. Weeds use moisture, from 300 to 500 pounds for each pound of weedy, dry matter produced, and this lost moisture may be seriously needed by the cultivated crop during dry weather. Weeds often make a very dense growth near the ground; this holds moisture, condenses dew, harbors insects, and may conduce to plant diseases; the weeds should be taken out and the plants thinned so as to insure a free circulation of air. The development of plant diseases is especially noticeable in weedy oat and wheat fields, which are much more likely to rust. Some weeds harbor plant diseases; mustard, for example, harbors club root which is transmissible to cabbages and other cruciferous plants. Members of the mallow family harbor a root rot that later attacks the cotton plants. Some weeds secrete a poison for the cereals; this is believed to be true of cocklebur for corn. Other weeds are poisonous to man and the domestic animals; cow bane and water parsnips come under this class of poisonous weeds. Injurious weed seeds are frequently so nearly the size and color of the grain they adulterate as to make it practically impossible to separate them. Cockle in wheat and buckwheat may be given as examples.

Some weeds are beneficial. Sweet clover is a valuable bee food, a valuable soil improver, and a good forage plant. The roots of tanweed were used for tanning leather. The artichoke is used for food and hog pasture. The little white daisy is, pound for pound, nearly equal to timothy and is eaten readily by farm stock.

Farm Practices to Free a Farm of Weeds.—As in the case with insects, so with weeds, there are certain farm practices to be known and followed before we need resort to special means for the eradication of weeds. The first farm practice to be recommended to help in the control of weeds is a wide rotation of crops. Land that is continuously cropped with corn and oats becomes infested with a number of weeds that cannot survive in the meadow and pasture. This is especially true if the land be seeded to alfalfa which is cut a number of times each season (Fig. 116), or if the land be pastured with sheep which are weed eaters.

Again, if a piece of land is pastured for a long time it becomes infested with weeds that survive in pastures but are easily

killed in a cultivated field or in meadows used for the hay crop.

The next farm practice to be recommended, after the wide rotation of crops, is to be sure that the seed gets a good start in clean ground. This means that the ground should be disked and harrowed just before planting (Fig. 117), that the seed must not be put in when the ground is too cold or too wet or too dry. It also means that none but strong, large seed should be planted.

Says Dr. Bailey: * "Weeds are plants not wanted. They are of two general kinds—those that inhabit waste or unoccupied

From "Productive Orcharding" (Sears).

FIG. 116.—Mowing is a good way to keep down weeds.

places, and those that invade crop lands. . . . All this sounds simple but it is a fact that we really do not know just why some weeds follow certain crops or how they injure the crops. It is commonly advised that the farmer do this and do that to destroy weeds, always putting the emphasis on the word destroy, but while it may be useful to prevent wild carrot from seeding, it is much more to the point not to have wild carrot. Much of the current advice on the destruction of weeds is of small value,

* Cyclopædia of Agriculture, Vol. II, published by The Macmillan Co.

for the farmer has little time or opportunity to hunt out the different species and then laboriously to prevent them from seeding or to spud them out. The fundamental thing is to apprehend the fact that certain weeds follow certain crops and certain methods of farming. Crop management, therefore, necessarily involves weed management. Some of the fundamental means of preventing weeds are good rotation courses; clean tillage; cleaning up waste places in which weeds breed; care in the choice of clean seeds and alertness to recognize new weeds when they begin to invade the neighborhood. This means that the farmer

FIG. 117.—A grape-hoe at work in a young orchard. An excellent implement for clearing out the weeds along the tree row. It will do the work of a dozen men.

should endeavor to determine why he is possessed of certain weeds; this discovered he can then begin to treat the question rationally."

The following is given as a typical treatment of one weed, the treatment of which is also applicable to other similar weeds.

The Horse Nettle (*Solanum Carolinense*).—"Those who have held that perennials cannot be acclimated will find an excellent exception in horse nettle. Darlington in his 'Flore Cestrica' makes the statement that horse nettle was introduced by Humphrey Marshall into his botanical garden at Marshalltown. The weed is still spreading. It now occurs from Con-

necticut, through New Jersey, New York, Pennsylvania, along the Atlantic coast to Florida, and west to Texas and Nebraska. It seems to be a native of the southeastern part of the United States."—Iowa Bulletin No. 42.

Methods of Propagation.—Horse nettle has two methods of propagation. One is by seeds and the other is by perennial roots. This makes it as difficult to eradicate as the Canadian thistle. Ordinary cultivation has little effect in checking it, and often helps to spread it by scattering pieces of roots. Horse nettle is more or less troublesome in all soils and all crops. It is an exceedingly tenacious weed and often covers whole fields.

Methods of Extermination.—There are a number of ways of dealing with horse nettle, among which are: Smothering, clean cultivation or hoe crops, mowing to keep from going to seed; but none of these is effective unless the farmer has a fair chance and applies the remedy with tact, skill and efficient equipment.

Smothering.—This may best be done with rape, millet, cane, etc. In case any of these are tried the crop should be sown late. Before sowing, the ground should be fall plowed and then disked frequently during the spring. The seed of the smother crop should be strong and sown thick, but not so thick as to make weak, sickly plants. When the crop has attained a rank growth it may be pastured or mowed and the ground immediately plowed and again disked or given clean culture until another crop is planted. If the patch is small, tar paper may be used to smother the weed.

Clean Culture.—For this, fall plowing is necessary. The old adage, "One acre in August equals two plowed in September, and one in September equals two plowed in October," holds for the eradication of weeds. If the ground is washy a late cover crop may be used, but the ground may be disked a few times before the cover crop is planted. The cover crop must be plowed under as early in spring as the ground is dry enough, and after that the ground should be disked frequently until the hoe crop of corn, potatoes, soy beans, etc., is planted. Then the crop must be cultivated frequently with efficient cultivators, for which the surface and disk cultivators are excellent to alternate with the shovel cultivator. Even with the best of cultivation it may be necessary to pull the weeds once or twice. The crop should

be removed early and the field plowed and disked if weeds appear above the ground.

Good Farming.—But these are the methods for the small patch and probably for the small farmer. For the infested farm of the larger farmer, good farming is the effective remedy. For this he must seek a rotation that will give him money—making crops which are inimical to the persistence of the horse nettle. Perhaps nothing better can be suggested than alfalfa followed by corn or potatoes, and these in turn followed by oats and peas cut for hay and the ground again seeded to alfalfa. The alfalfa is cut three or four times in a summer.

Another part of good farming is the securing each season of clean seeds, another is the attention to fence rows and corners to see that few if any plants go to seed there, and yet another farm practice is the seeing to it that weed seed is not brought on to the farm from neighboring places. This often requires that a man become a crank to see that the State laws for the mowing of weeds along the road-side are enforced. Many weed seeds are scattered in manure and to prevent this it may be necessary to compost the manure. To prevent too heavy loss for the compost it may be necessary to mix with it land plaster or a calcium phosphate ground rock.

Other Weeds.—It will readily be seen that what has been said for the extermination of horse nettle applies to the extermination of the European bind weed, commonly called Morning Glory (*Convolvulus arvensis*), and Canadian thistle, which, like the horse nettle, multiply by both seed and rootstock. The bind weed is easier in one way, for into the rotation may be introduced pasturing, especially with sheep, following the alfalfa.

Exercises.—If the pupils did not learn of the poisonous plants in their nature study, then it is in order for a series of lessons on the poisonous plants, to be given as part of the work in agriculture. Among the poisonous plants we find poison ivy (*Rhus radicans*), poison sumac (*Rhus vernix*), water hemlock, corn cockle, broad-leafed laurel, and black cherry. Certainly, children should be taught how to identify each of these plants, how the plant poisons and hence how we may avoid its injuries, and how best to eradicate the plant. Poison ivy, for example, is easily identified by its three leaves, while the five-leafed ivy does not poison, hence, while we may use the five-leafed ivy for decora-

tions, we must fight the three-leafed ivy wherever found. The three-leafed ivy poisons by means of an oil which is thrown from or secreted by any part of the plant. Men have been very seriously poisoned by pulling out the roots while plowing. The plant should be handled with gloves and should be hoed or mowed by persons not easily poisoned.

The ability to analyze a sample of seed so as to tell its purity is a valuable accomplishment for any farm boy. Teachers may use the same plates which we use for soil study (Fig. 70) to analyze seeds. A sample of one hundred or two hundred seeds may be poured on to a plate for each pupil. Then each pupil may be required to separate one hundred seeds into the grain being examined, one or two known weeds, and one sample of unknown impurities—broken seeds, unknown weed seeds, dirt, etc. By taking the averages for a class, a school learns very accurately the per cent of weed seed in a sample. The farmers should be able to get their clover and alfalfa seeds analyzed by their schools free of cost and in an accurate, reliable way. Interesting problems in arithmetic follow by figuring on the fraction, the percentage, the ratio of good seed to certain kinds of weeds, the value of the seed, the relative value of different dealers' samples, the number of weed seeds that would be sown per square rod, and the relative loss on the sample.

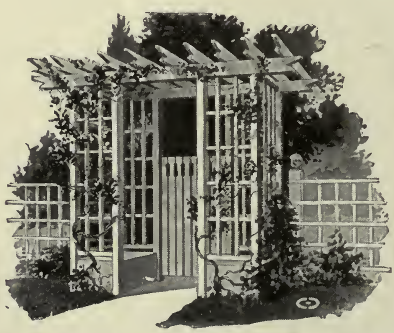


Fig. 118.—We may use the five-leafed ivy for decorations, but not the three-leafed ivy.

QUESTIONS AND STUDIES

What have you learned about:

1. Weeds in nature study?
2. What a weed is and of what benefit it may be?
3. How weeds injure the farmer?
4. What farm practices to be followed to rid a place of weeds?
5. How to rid a place of the horse nettle?

What can you learn about?

6. What are the ten most troublesome weeds in your district?
7. What farmers do to keep them down?
8. What your State laws are regarding the cutting of weeds?
9. What chemicals are derived from weeds?
10. What medicines are derived from weeds?

References.—Farmers' Bulletin No. 380, The Loco-Weed Disease; No. 306, Dodder in Relation to Farm Seeds; No. 86, Thirty Poisonous Plants; No. 464, The Eradication of Quack Grass; Ohio Experiment Station Bulletin No. 175, A Second Weed Manual; Percival, Agricultural Botany, Part V, Weeds; Bergen and Caldwell, Practical Botany, Chapter XXV; Cyclopedia of Agriculture; Texts in Agriculture; Pammel, Weeds of the Farm; Georgia, Manual of Weeds.

I warn my countrymen that the great recent progress made in city life is not a full measure of our civilization; for our civilization rests at bottom on the wholesomeness, the attractiveness, and the completeness, as well as the prosperity of life in the country. The men and women on the farms stand for what is fundamentally best and most needed in our American life. Upon the development of country life rests ultimately our ability, by methods of farming requiring the highest intelligence, to continue to feed and clothe hungry nations; to supply the city with fresh blood, clean bodies, and clear brains that can endure the terrific strain of modern life; we need the development of men in the open country, who will be in the future, as in the past, the stay and strength of the nation in time of war, and its guiding and controlling spirit in time of peace.—ROOSEVELT.

The Department of Agriculture and the agricultural colleges are as much in need of the farmer's wisdom and the accurate knowledge of the farmer's problems as the farmer is in need of the information which agricultural institutions can give. Active and mutually helpful coöperation is needed. . . . The farmer needs the facts and the explanations which the scientist can furnish. The scientists and teachers are no less in need of the facts and the point of view of the farmers; they need to learn the superscience which farmers call common sense, that wholesome wisdom that is the essence of the thought and experience of generations of men who have made good through work and thought and thrift and unconscious adaptation to circumstances.

In every county it will be found that most of the serious agricultural problems have been solved by several of the good farmers. There is no better way of teaching a scientific truth than by calling attention to some one who is successfully practising it.—U. S. DEPARTMENT OF AGRICULTURE in *Weekly News Letter*.

CHAPTER XIII

RURAL LIFE INSTITUTIONS

Agriculture a Mode of Life.—The study of agriculture means more than the study of how to make a material living. Agriculture is a mode of life. The study of agriculture is partly the study of how to find happiness in the open country. To be sure agriculture must be relatively profitable and respectable, but it will never be satisfying unless we learn to find beauty in grass and flowers, in birds and trees and ripening grain; it will never be satisfying unless we have, as our ideal, plain living and high thinking. Agriculture is satisfying when we find that we have in it a "work that none other can do."

The Country Life Problem.—Our country life problem is the problem of making the country attractive to people of ability and initiative. It is the problem of making country life satisfying to vigorous, capable, and enterprising young men and women. There is danger that the desire for the "conspicuous consumption of wealth," that the "lure of the crowd," the craze for the show, the pomp, and the chances of the city will attract the leading young men and women from the country. The problem, then, is the problem of how to maintain a stable population in the country. Before we can do that we must realize keenly the necessity for redirecting and revitalizing certain social institutions. Teachers are moulders of public opinion and hence, before they go to teach in the country, should have a good course in rural sociology. Rural sociology has been neglected in both our agricultural colleges and in our normal schools. This is not the place for a full treatment of all of the social problems of the country. I lack space to treat of a number—the liquor problem, the labor problem, the restricted markets, the unfair banking system, the antiquated taxing systems and a number of others. The discussions of our rural social problems have recently called forth some excellent books among which are the "Report of the Country Life Commission," Bailey's "The State and the Farmer," Butterfield's "Chapters in Rural Progress," Cubberley's "Rural Life and Education," Gillet's "Constructive Rural Sociology," Betts and Hall's "Better Rural Schools," and

Wilson's "The Church in the Open Country." In this chapter I wish to treat briefly of the following:

1. Rural coöperation.
2. Better roads.
3. The country church.
4. Efficient rural government.
5. The country home.

COÖPERATION

Rural Coöperation.—Students who have visited Denmark and have made special efforts to ascertain the secret of her wonderful agricultural development attribute that development principally to two causes; namely, agriculture in her rural and secondary schools and her efficient rural coöperative organizations. In the United States, bankers gather money to loan to town business men. Sometimes bankers make farm loans for people in other parts of the country. But farmers, especially in the east, cannot borrow money for five, ten or twenty years, at rates as low as are made to corporations. In Denmark and parts of Germany, farmers themselves organize the loan associations where farmers can borrow for a long time, at lower rates than town people pay. This is as it should be. Farms and farm products are the best security in the world. The facilities for enabling farmers to borrow money at low interest, for a long time, make land ownership attractive. Renters do not as a rule make the best of farmers. The love of ownership is an instinct almost as deep as any in the human heart. No country can hope to make farming popular to people of ability, unless that country makes it easy for the actual tiller of the soil to own the soil which he tills. When we organize institutions and make laws so that the actual farmers have the advantage for borrowing money on land, we make land ownership attractive to the people in the country and unattractive to the speculators and the retired landlords in towns. This is just the reverse of what we have in the United States to-day. We need coöperative farm loan associations in the United States, and of late there has been much agitation for farm credits, and such associations.

And we need coöperation in other lines. Each of a half-dozen farmers may be able to buy a fairly good breeding animal, but the half-dozen by coöperating could afford a first-class animal.

Again, each farmer may sell a few bushels of apples, potatoes, peaches or whatever it may be. Each may have articles of a variety different from those of his neighbors. There being no reserve supply, the merchant does not desire to take the articles and work up a demand among his customers for them. But if the farmers would coöperate and get together enough of any one variety, they might be able to command the very best market.

It is claimed that our colleges have failed to show young people how to go home and get people together. Coöperation offers us a great opportunity. Its beginning should be in the country home, the school and the country church. These must be socialized, that is, made interesting and helpful to all. From learning to help others while in the country home, the school and the church, the child grows into habits that will enable him to be a helpful member of a coöperating society. We must become keenly conscious of the economic advantages of coöperation in order to enable us to overcome the individualism and isolation which the farmer is accustomed to. We have overdone the theory of competition. It is coöperation and not competition that enables a group or a people to do well in the economic world. If teachers believe that more coöperation is needed in their districts, the teachers must read and talk about it until the farm folk live it before we expect them to get pleasure from coöperating. Two good books on coöperation among farmers have recently been published; one is Coulter's "Coöperation," and the other is Powell's "Coöperation in Agriculture." Another helpful book for teachers to read is Curtis's "Play and Recreation for the Open Country."

There is a revival of interest in the Grange. This is to be encouraged for in the Grange the farmers learn to work together, and to discuss matters of vital and mutual interest. The Grange has taught more farmers to coöperate than has any other single institution. The active Grange is a typical rural institution that has a program to help rural people and knows definitely what it is aiming to do and what there is to be done.

GOOD ROADS

Better Roads.—Our country is new and the pioneer was too busy conquering a continent to build good roads. Distances are great in America and hence good roads cost more *per capita*

than in other countries. We have been making so many inventions, railroads, trolleys, traction engines, automobiles and the like that we have not been sure just what we wanted roads for or who should pay for them. Then, too, the pioneer was followed by the land speculator who robbed the soil, neglected the school, the church and the local government, and who cared nothing for good roads. He was waiting for unearned increment, and he

Fig. 119.—How to make good roads as taught at Iowa State College.

left us many serious problems. Let us hope that we are nearing the time when the men on the farms will be the true husbandmen, who live in the country because they love the country and who till the soil because they love the soil and love to make it produce. These true husbandmen will be in the country to stay, and they will want good roads over which to haul produce, and over which to go to church, to school, and Grange and other social gatherings.

Educate Road Builders.—I fear that we are beginning at

the wrong end. We are appropriating money for good roads before we have men educated to use that money honestly and wisely (Fig. 119). We are appropriating money for good roads before we have public opinion trained to criticise the use of money expended for making the roads better. Public opinion is alert to find fault but, since it finds fault with almost everything, public criticism fails to count as it should. A sharp, clear discussion in our schools, at least once each year, of what constitutes a good road, of what material it should be made, and what it should cost and who can build it most economically, would in a few years give us a public opinion that would do much to insure efficient road makers and efficient use of public money in building roads. When the great pastor, Frederick Oberlin, began his remarkable work among the country folk of the Vosges Mountains, he began by helping them to build a better road. One of the first signs of rural decay is neglect of the roads, and one of the first signs of rural regeneration is the making of a good road. Wonderful progress is being made in discovering better road-making materials and in learning how to use them. No country boy should become a man without being put into touch with the sources of this information and without being made conscious of where good roads are to be found and how they were made. Farmers' Bulletin No. 505, "Benefits of Good Roads"; No. 597, "The Road Drag and How to Use It," and the United States bulletins of the Office of Public Roads should be in the school library and read by those interested in building better roads.

THE COUNTRY CHURCH

Mission of the Country Church (Fig. 120).—Life in the country cannot be made satisfying unless the local church minister reasonably well to the spiritual and social needs of the country people. If a church is dividing the people into sects instead of uniting them into coöperative bodies (Fig. 121), if the church is unattractive or, what is equally bad, attractive to the least intelligent only, it cannot hope to do its work among country folk. If the well-to-do and the brighter people are not interested, they will stay away or leave the neighborhood and the church will come more and more under the domination of the less capable

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people. But under the right leaders, a rural church may become one of the most helpful institutions. It may build up and stimulate the spiritual life, cheer the faint-hearted, and minister beautifully to the intellectual, social, æsthetic and moral life of the community. In its meetings, suppers, and social gatherings may be nurtured the coöperative spirit which is the natural order for life above the brute. If there is such a church in the district, it should be the business of the teacher and the school to coöperate with it in order to enable it to minister as best it can to the people of the district.

The Church and Religion.—Of course the primary interest of the rural church, as of any church among us, is to bring the Christian religion to all the people of the community. We are not yet spiritual beings. Without constant help, we easily lapse into immorality and barbaric practices. Hence, as Dr. Gladden says, "The test of efficiency of the church is the moral condition of the community." Most rural districts are over-churched. Many places cannot pay enough to attract reasonably capable pastors and they cannot pay enough because they are trying to support too many churches. Then, too, we have had no pastors especially prepared for the rural life work. The minister for the rural church needs a broader and deeper preparation than the man for the city church. In the country the preacher must avoid emphasis of sectarian doctrines. What is needed is the man who can preach to plain, open-minded people the real gospel, the reality of God, the value of human life and endeavor, the gospel of a Saviour, the law of sin and its penalties, the great social teachings of Jesus, and the awful waste of human life and resources in war and through sin of many forms such as vice and crime, drink and other forms of intemperance.

FIG. 120.—Washington used this meeting house for a hospital and the farmers have used it for 150 years for worship.

Rural Pastor.—It is needless to say that the rural pastor, like the rural teacher, should be a member of the community,

that is, live in the country and be one with the people among whom he labors. The pastors who have been most successful in the country are the pastors who know something about scientific agriculture. The rural pastor, like the rural teacher, should be a member of the Grange, and should take an active interest in the rural work being done by the Y. M. C. A. and the Y. W. C. A. The Eight-week Courses prepared by Miss Jessie Field, National Rural Life Secretary of the Y. W. C. A., are sending young women from the colleges back to their home dis-

Courtesy Wallace Farmer

FIG. 121.—A $40,000 rural church in Iowa. This church building shows what farmers can do when they coöperate.

trict able to help the rural pastor. These young ladies, when they become teachers, are to be of more service to the communities in which they work.

Religion and Life.—Country people do not know how to play. They have never been taught how to enjoy vacations. The Y. M. C. A. and the Y. W. C. A.* are organizing the young people and conducting summer camps. In Miss Field's county, when she was County Superintendent, she had summer camps for

* The Y. M. C. A. has a national magazine, *Rural Manhood*, and the Y. W. C. A. gives special numbers such as March, 1914, of the Association Monthly to the rural life work.

boys. These were conducted by the Y. M. C. A. Part of the time was spent in play, but two hours each day were spent in the study of religion and two in the study of vital, interesting agriculture—stock and grain judging, stunts, rope tying, seed corn tying, and other things that offered opportunity for contests and activity. The three great agricultural people of the world who never separated religion and agriculture are the Scotch-Irish, the Mormons and the Pennsylvania Germans, and all three are noted for what both agriculture and religion do for their people. Certainly the teacher who understands that education is more than book learning, must seek to understand the powerful influence of religion. She must be keenly conscious that a base people makes a base religion and a base religion helps to make a base people. She must be keenly conscious that a noble man is the highest creation of God and a noble God is the greatest discovery of man. She must be in perfect sympathy with the Good Book which says, "And the Lord God took the man and put him in the garden . . . to dress it and to keep it."

Patriotic Responsibility.—Just at this time in our history the rural church in America has a great responsibility. Christians must be better farmers than non-Christians or the country will become non-Christian. Here is our dangerous race problem. If the native stock has a standard of living requiring a higher consumption of wealth than can be satisfied in the country, other peoples with lower standards of living will accumulate wealth in the country, buy the land and own the farms.

The native Americans must be taught to lower their standard of consumption or, what is better, taught to manage and farm so as to accumulate money. The church has not always remembered this and hence in many places it is noticeable that church people do not make money by farming. In many places the foreigners are the better farmers and the more thrifty people, and they are becoming the landowners while the sons and daughters of the native stock are drifting to town. This is the real danger from the Chinese and the Japanese races.

RURAL GOVERNMENT

Rural Government Inefficient.—Rural government in the United States to-day is inert and dead. People should not be asked these days to die for their country but they should be

asked to live for it. We need men and women who have made a special study of rural government and governmental problems. We need more men who live in the country and have time to take hold and, without necessarily holding office, see to it that money used by rural officers is economically used and that officers do the work of governing the country as well as do the officers in our best governed cities. We have had inventions for city governments such as the commission form, the juvenile courts, the humane office, and others; why not have inventions for governing the country? Instead of local farmers being constables, we need mounted police like the mounted police of Canada. Certainly we need police who will make melons and fruit as safe in the farmers' patches as they are in the merchants' stores. We need officers who will make eggs and poultry as safe in the farmers' hen houses as they are in the city man's meat market or store. Let us hope that we may be able to find a more satisfactory judge than the ordinary farmer who frequently acts as Justice of the Peace.

The inference is not that everything in the country is bad, but the world is advancing, and rural social institutions should change as freely and keep as well up to date as are farm methods and farm machines. The reason rural government lags behind is that farmers are conservative and they are busy, law-abiding people, and hence do not use the machinery of government enough to keep it in good running order. But, as with fire protection, they need it in times of emergency. There are places in the United States where the better families will not live. Womanhood is not safe, property is not safe, and good land in those districts is selling for one-half of what it is in other places. The efficient race will be the ruling race. The efficient community is the advancing community; let us have wise minds to consider what changes are best, and to see that the country people are protected by government as efficiently as are people in the best governed cities. Nothing less will make the country attractive to the best families.

THE COUNTRY HOME

The Home Necessary in the Country.—Of all the institutions in the country, the home is the most necessary. No other occupation has the home and the business so closely related.

Farming is necessarily a co-partnership between a man and a woman. Town people may board and carry on their business, but not so with farmers. In the farm home must be manufactured much of the raw material into the finished product of food, clothing, or packed articles for the market. In town there are many lines of business which an unmarried man or woman may carry on quite as conveniently as a married man or woman, but it is not so with farming. If a man or woman has no helpmate willing and capable of doing his or her share, that person should not enter farming as a life work.

Children Welcome to the Country Home.—This is a time of decreasing birth-rate, especially among enlightened peoples. Some view the decreasing birth-rate as a sign of the decay of our civilization. If the college graduates continue to multiply no faster than they do at present and if the lower classes continue at their present rate, in ten generations the lower class will outnumber the educated class 65 to one. Cities and towns are places with childless homes. The country is the place for the real home and it is to the country home that we expect to find children welcomed. This is so for a number of reasons. Country people have different ideals; food and clothing cost relatively less, children are able to do more, and what they do is worth more than it is in town. Hence we do not expect to find the country infested with the childless homes, the middle-aged unmarried men and women—all three of which are pathological for any society. As explained above, our rural life problem is the problem of making the country satisfying to people of brain and strength of character who will make the building of a home their life work. If we fail here we believe that our whole civilization is to fail just as did the civilizations of Greece, Rome, and Spain. In addition to the country being the place where children are more frequently welcomed, where their food and clothing cost relatively less and their work brings relatively more, there is the additional fact that in the country what children do is educational. There are stronger arguments against child idleness than against child labor providing what the child does, he does with father or mother, out-of-doors and at things varied enough and simple enough for him to comprehend. The country, then, is the place where we may hope to find happy homes for happy children.

The Country Home and the Country Woman.—As stated in Chapter I, the drift to the cities has been largely because woman has failed to find the country satisfying. "No other single issue," says Mabel Carney, "has more bearing upon rural depletion and the general farm problem." Just as the strength of a chain is determined by its weakest link so will the progress in solving our rural life question be determined by our ability to make farm life satisfying to vigorous, capable, enterprising women. But we have had no adequate discussion, to say nothing of education, to enable us to make the country satisfying to women. Few people, for example, know the relation of woman to the different sized farms. The woman who is overburdened is most apt to be found on the medium-sized farm—farms from 100 to 160 acres. If the farm is larger, there may be a tenant house and one of the hired men may be a married man with a wife willing and able to board the other hired help. If the farm is a small fruit or market garden place, it is apt to be near some town where labor may be hired by the day. Then, too, the equipment is apt to be most helpful in the home near town or in the home on the larger farms. This means that men and women should become conscious of the fact that if the woman is not strong, her husband should avoid renting or buying the middle-sized farm, especially if it is some distance from town. Certainly the woman on the middle-sized farm has a right to all of the modern conveniences such as gas or oil with which to cook, telephone, running water and some form of power, all of which will be discussed. Added to these she needs rural delivery, the parcels post and some form of mounted police or State constabulary protection.

A Score Card for the Country Home.—When we have a friendly contest to see who has the best home in the neighborhood, or when we make surveys to see what can be done to improve the homes of a district, we use a score card. The following has been found a convenient one:

Country Home Score Card

	Points
1. Beauty	10
2. Wise expenditure of money	15
3. Sanitation	20
4. Modern conveniences	15
5. Labor-saving machines	10
6. Food	30
	100

Beauty in the Country.—Country homes cannot be satisfying unless they are beautiful, but the beauty must be the beauty of the country and not a cheap imitation of town things. This is partly a matter of mental attitude and partly a matter of education. "It is a new thought of high art," says Powell, "that is growing among the people, that instead of buying pictures to hang on our walls, we may better create them on sod, with living plants and running brooks. We are going back to God, intending to cowork with him." There is a difference between what is beautiful in the town and in the country. The man in town who has little land and much labor may have the Italian garden and formal beds in his lawn, but these are not beautiful in the country because they are suggestive of much labor, and the farmer already has more labor than he can do with ease and pleasure. One horse equals five men, therefore the country man should have his lawns and gardens so arranged that they may be cared for with horses. It is much easier for the countryman to mow an acre or more with a team or horse mower than it is for the town man to mow a quarter of an acre. Of course the town man may need the exercise but the countryman does not.

Landscape Gardening.—Boys and girls in the country need good courses in landscape architecture. They need to be taught how to appreciate and make beautiful vistas, open lawns, fields and meadows. They must learn to enjoy well-fenced fields with healthy, contented animals in green pastures. The door yard should be simple and easily kept clean. Most people make the mistake of over-crowding. Trees must be neatly and well trimmed. If trees need "doctoring" the work should be neatly and skilfully done. Most of the flowers should be hardy perennials, some of which are in blossom throughout the season. Unsightly places should be screened with evergreens, ferns, and shrubs. The vegetable garden must be in the background and preferably screened by a hedge. The plantings should be massed, the centre spaces should be open, and straight rows should be avoided except along roads and fences.

The Country House.—We must develop an American rural architecture which appears to grow out of and to fit the country. The first principle for beauty for the house will be simplicity. The house does not need to be costly but it must be large enough

to furnish ample room (Figs. 122, 123). The tired farmer goes to the house to rest. The country woman who has the simple house has the house most easily kept clean and attractive. The little fussy decorations and concoctions of the town houses were put on because some carpenter persuaded some man to furnish work for the carpenters; or, worse yet, because some man had money which he wished to spend for display. The jig-saw ornaments, the mill-brackets, mouldings, fancy cornices and railings and towers and breaks in the roofs that soon get out of repair and leak during heavy storms—all such vulgar displays are for people with "folly farms" who are in the game called

FIG. 122.—A country home. Notice location of house, wood-shed and machine-shop relative to barn.

the "conspicuous consumption of wealth." Beauty is fitness for function. If a part of a house is not necessary, it should be removed for it is not beautiful. Simplicity, utility and good workmanship make almost anything beautiful.

Country House Score Card.—For the country house the following score card has been used by some of our most noted judges. *Country Life in America* used this score card to judge the relative merits of different country houses built during the summer of 1914.

Country House Score Card	Points
Plan	35
Exterior appearance	25
Interior equipment and furnishings	25
Setting, arrangements of paths and gardens	15

Wise Expenditure of Money.—Farm buildings are not beautiful when they cost more than a farmer can afford to pay. This applies to barns and house—they must not appear to be burdens on which one must pay interest and depreciations. A wise expenditure of money calls for the buildings to appear to have been made out of native material. But the buildings, especially the house, should look as though it was built to last. It should make one feel that it is efficiently protected from wind and lightning. Cement, while it costs more than wood, lasts well and fits into

Fig. 123.—A country house. The house in Fig. 122 could be made to appear like this at a very little cost.

almost any surroundings. A wise expenditure of money requires that the buildings be conveniently located for carrying on the farm operations. The real husbandman must resist the temptation to copy after town men who have "folly farms" in the country.

Sanitation.—The house should be so located that the drainage is toward the other farm buildings or at least away from the house in every direction. The terrible scourges of typhoid fever and diphtheria on the farms tell us that outhouses and wells are frequently in too close proximity. When the house is built

or remodelled we want a modern sewer system and this calls for a chance to reach lower ground than that on which the house stands. The house can hardly be called sanitary if it lacks a modern bathroom and convenient wash rooms for the men as they come in from work. The cellar of the country house should be light, clean and well ventilated. The vegetables should be stored in a separate vegetable cellar. This same vegetable cellar, if well made of cement, costs but little and makes a splendid protection against the tornadoes which so frequently terrorize families in some sections of our country. The countryman is to have no rooms that are not well aired every day. The air in the country is not to continue to be "so fresh because the country people keep all of the bad air locked up in their barns and houses." The country house should be easily ventilated and, since sunshine is the best of disinfectants, bright sunshine should penetrate every corner of every room in the house, some part of each day.

Labor-saving Conveniences.— Over 95 per cent of the farm homes in one State where a survey was made have no bathrooms. Over 90 per cent have no running water. A farm woman doing the work for an ordinary family should use something over 100 tons of water each year. This she must lift two if not three times over. Think of making a woman lift something like 250 tons of water each year! A modern bathroom with running water, both hot and cold, can be placed in an ordinary house for less than $150. Certainly this is a woman's just racial inheritance. Of course a woman must have a telephone, for she is alone too much to do without one. She needs and should have a modern heating plant if nothing more than a good hard coal burner and radiators for the rooms above. She must have a first-class sewer system and she needs a separate room for the laundry. This may be in the basement or cellar if it is light and properly equipped with tubs, drier, etc.

The Kitchen.—But of all places in the country home the kitchen is the most important. In our clubs for girls we must have discussions of how to make woman's work more efficient. Since 14-year-old club girls are able to can 300 quarts of garden truck in a day, there is no good reason why a woman should make a burden of canning enough for a family's winter use. Then, too, the replanning of the kitchen so as to save steps makes a

fascinating topic for discussion. The two kitchens given in Figs. 124 and 125 tell their own stories. The woman doing work in the kitchen of Fig. 125 must walk forty miles farther each year, if she does the ordinary work for a family of five, than she would have to walk if she were doing the same work in the other kitchen

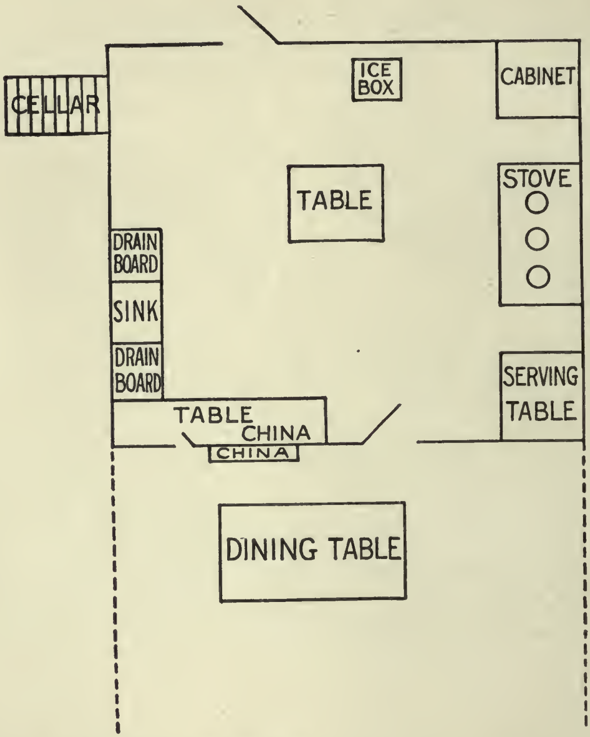


Fig. 124.—The efficient kitchen after Mrs. Frederick. Dishes going to and from the kitchen take the shortest possible course. Steps are saved from cabinet to ice box, from cabinet to stove and to serving table.

(Fig. 124). Besides, she must lift some 100 tons of water more in kitchen, Fig. 125, than in kitchen, Fig. 124. Home management is quite as important as farm management, and while the boys are studying how to remap the farm the girls may well study how to remap the kitchen. Women need vocational education quite as much as men.

Labor-saving Machinery.—The ideal farm should have a small building about midway between the house and the barn. In this building there is to be an engine capable of transmitting power to either the house or the barn (Fig. 126). On the larger farms the machine will be one that generates electricity which may be used for either light or power. Our notion of what is proper for man and what is proper for woman to do came from

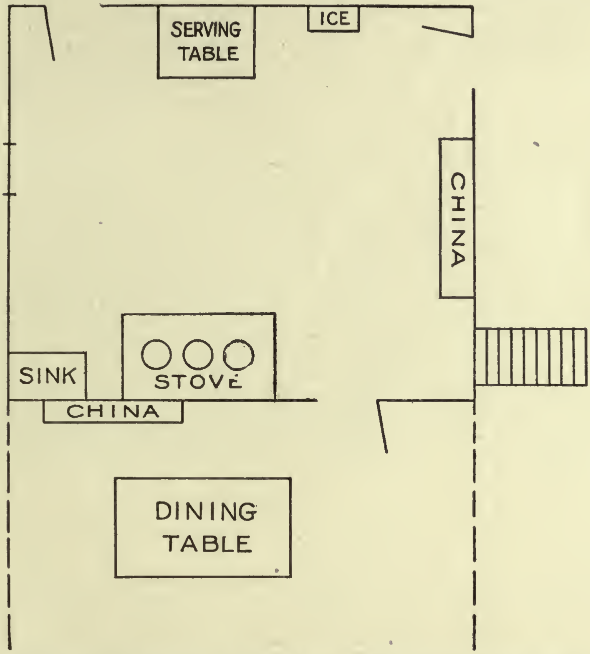
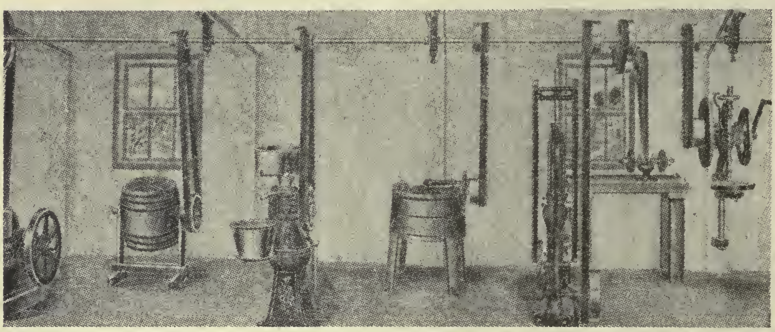


FIG. 125.—A too common kitchen. A woman doing work in this kitchen must walk forty miles more each year than she would have to walk in kitchen given in Fig. 124.

colonial farm conditions. It is time now to discard part of it. The overworked woman who has her own washing or churning to do should have the help of some machinery, and this machinery should be tended if not run by one of the men on the farm. If the machinery is efficient, it does not need to take all forenoon to do a washing. The invention of the steam-power machines led to the concentration of power in the factories and that led to the building of modern cities. Now power must return to the

country to make the country attractive to women who need surplus energy to help in community affairs. The washing machine, the wringer, the churn, the separator, the clarifier, the pump, the milking machine, if not the lights, should use some kind of power such as a gasoline engine or electric current.

Food for the Country Home.—Country people work hard and hence should have an abundance of wholesome food. Food in the country is relatively cheap. The directions given in Chapter VIII, for making a chart to see what fruits and vegetables a family may have each month in the year, make valuable exercises to use for food surveys for the country homes. If club girls learn to can garden truck in the modern canners (Fig. 38)



Courtesy Successful Farming.

FIG. 126.—Power for a country home.

they may add much to the food for the farm family without making the canning a burden. A ten-dollar outfit enables a 14-year-old girl to can 300 cans in a ten-hour day. We are learning that some vegetables, such as corn and peas, for example, deteriorate very rapidly after being gathered. Country people may can corn that has not been gathered more than one hour and make it so nearly like the fresh ears from the field that competent judges cannot tell the difference. Eggs and milk and the leaves of plants—lettuce, spinach, cress, cabbage—are the foods that give children muscle and bone, and these are the very foods that country people find easiest to get and most easily prepared. We do not want our schools when they teach domestic science to teach the girls how to prepare hospital dishes for sick people. We want the farm girls taught how to prepare dishes that keep

people well and strong. We do not want the domestic science instructors to teach girls to cook on little fussy electric or gas irons; we want the girls to learn to make a fire in a kitchen range and make it easily and efficiently. We need the surplus energy of woman in the country to help in community affairs. She is to enjoy life more when she has more to do in shaping and conducting community affairs. This energy is to be freed by making her work more efficient, she is to work with better equipment, in plain but more beautiful homes, and she is to find happiness in preparing plain but wholesome food for happy, healthy, well-fed children and husband.

Farm Planning.—For the farmstead the following rules have been adapted from Professor J. B. Davidson's list:

1. Have the buildings near the centre of the farm, giving due consideration to other advantages.
2. Have the buildings on a slight elevation whenever possible; a southern or eastern exposure is desirable.
3. Buildings should occupy the poorest ground, but be on well-drained soil.
4. Buildings should be conveniently located with reference to water supply.
5. A timber windbreak should be secured.
6. A garden and fruit plot should be near the house but not conspicuous from the road, and screened from the house.
7. Pastures should be adjacent to the stock barns.
8. The buildings should be so arranged as to serve as windbreaks.
9. Buildings should be located on the side of the farm convenient to school, town, church and Grange hall.
10. The buildings should not be located on a high hill inaccessible from fields.
11. The buildings should not be located in low valleys on account of lack of air and water drainage, also danger from frosts.
12. The shop and machine shed should be convenient to house, barn and fields.
13. Where there are streams, the fields should border the streams so as to facilitate cultivation, watering stock and drainage or irrigation.

14. Have as many fields as possible in direct contact with the barn (see Fig. 65).

15. The size of the fields should be in proportion to the size of the farm and the system of rotation. Fields should be of nearly the same size.

16. Land of the same quality should be in the same field. The number of fields must be regulated by the system of rotation. (See Farm Score Card, Chapter VI.)

A HOME FOR THE TEACHER

The "Teacherage."—The housing of the teacher for the country school is one rural problem of which country people are unconscious. But, as National Commissioner of Education Claxton says, the housing of the rural teacher is one of the vital problems for the country. The country needs leaders. It needs social leaders most of all. We cannot hope to make teaching in the country attractive to men and women of ability unless we furnish them a reasonably comfortable and happy place in which to live. Recently, I said to a director of a school soon to be consolidated, "Whatever you do to the old school-house, do it so as to make of it a home for the teacher when you get the new consolidated building in the yard across the road." "That is so," replied he, "but I never thought of it before." I am of the belief that this is one of thousands of similar cases in the United States to-day. There is an old school building. The building is too small for a consolidated school but it may make a comfortable house for the teachers of the consolidated school. To be sure the roof must be raised and another story added. The place must be beautified but, since it is to belong to the district, let the children have a part in selecting material for beautifying the place. The landscaping of the yard may well make a school problem and the lessons learned from that applied for years to come in beautifying the homes of the district. Dr. Bailey says somewhere that instead of abandoning the old school-house, he would like to see a school, a church, a museum and library and a Grange hall on the four corners of the crossroads. Let us add to his four buildings a home for the teachers to be near the library-museum or, what may be better, let the museum-library be in the new consolidated building and the fourth corner be occupied by the home for the teacher. We have long had par-

sonages for the preachers, why not "teacherages" for the rural teachers?

"Teacherage" for the Redirected School.—Farmers are too poor and the school of to-day enters so little into their thought that they simply will not be taxed for a teacher's home. The school is not doing much directly to help the farmers economically, and hence the farmers are not willing to give the school the economic support which it deserves. But with the coming of home projects to be supervised by the teacher, with the making of the school the centre for the dissemination of information from the Farm Bureaus, the State Experiment Stations and the United States Department of Agriculture and Education, there will come a very different mental attitude toward the economic support of the school.

Teachers Should Live in the District.—The teacher should live in the district and be a part of it socially. His house should be near the school-house. The teacher of agriculture should be hired for twelve months in the year with the privilege of having a month's vacation in the winter. The writer has in mind one town in Massachusetts which hires the teacher of agriculture for twelve months in the year with the proviso in the contract that he may be off two months in the year, providing one of the two months be spent in some approved agricultural college.

The school should be the teacher's summer office. He should make constant use of its laboratories, its library, its microscopes and other apparatus. The building should be provided with a good telephone, and if a farmer is in need of information on a certain problem he should be able to ask over the telephone whether the school library or laboratory has any answer to his problem. If he has a topic to discuss in Grange, Farmers' Club or other meeting, he should be able to go to the school-house to study his topic and the teacher should be the assistant librarian to help him.

Home Projects.—In Minnesota and Massachusetts they have some of the actual farm work supervised by the teacher of agriculture and the home work by the teacher of domestic science. There pupils carry on home projects, a discussion of which was given in connection with the subject of Pets in Chapter III. These home projects are an organic part of the pupil's school work. He must succeed with his home project or fail to make

his grade at school. If his project be a three months' project, he takes up a new project at the end of the three months but carries on his old project without the supervision of the teacher and without receiving so much credit for the old project in his work at school. Some projects require three months and some require six months or a year. This home project work makes of the teacher of agriculture a man who resembles the County Agents of the Farm Bureaus, except that the teacher of agriculture works for a district or township only instead of for a whole county. There is great need to-day, in nearly every rural community, for just such a man. There is hardly a farm problem that some farmer somewhere has not met and successfully solved. There is need of some person whose business it is to know where that farmer lives and to reveal him to his neighbor who is in need of his help. Then, too, the number of questions that are being sent to the State Experiment Stations and the United States Department are so numerous and some of them so poorly worded that they do not get the attention which they deserve. If the question is one to be answered by the State Experiment Station or by the United States Department of Agriculture, the teacher is the one to tell a farmer so, and to help him formulate his question so that it will get the attention it is entitled to. It may be a specimen is to be sent and the farmer neither knows how to gather the specimen nor how to ship it. The teacher of agriculture is the man to help him. It may be that the question is best answered by an experiment in the home district; if so, the teacher of agriculture is the right man to help some one to try that experiment. This makes the work of the teacher of agriculture an organic part of the economic activity of the district. It makes it necessary for the teacher to have a " house by the side of the road." And it enables the teacher to return to the district, many times over, the rent for the teacherage and to make the school the centre of interest for the community.

Material for Home Projects.—There is certainly material enough for home projects. Coöperative buying and selling is a good undertaking for a boy or girl who has the time and the business ability. The school-house should have on file at all times a full list of markets and quotations of farm supplies. The making of a piece of good road, the helping in the rural church, the making efficient of some part of the rural government, the

helping on the farm and in the country house, growing an acre of corn or potatoes, the care of poultry, the breeding of garden vegetables, the making of pastures and hay fields, the rejuvenating of an old orchard, starting alfalfa, soy beans, cowpeas or other new crops, the testing of different varieties of grain, the testing of dairy cows and a hundred other things may be taken up as home projects. Human life is complex and the farmer's life is the most complex of all. He must be master of weather, markets, men, forces, animals, plants, diseases, and with it all help to furnish social and religious activities for the community. For this he needs institutional help. The school is the institution to help him, but how different it must be from the rural school of to-day! But of one thing we may be certain—change is inevitable. The teachers who will not change cannot continue to control the rural schools of to-morrow. The rural school requires a chapter by itself, for the rural school occupies the strategic point for the reorganization of rural social institutions.

QUESTIONS AND STUDIES

What have you learned about?

1. What our rural life problem is?
2. How coöperation may help to solve it?
3. How good roads may help?
4. What the rural church may do?
5. The importance of the rural home?
6. The characteristics of a good rural home.

What can you learn about?

7. Whether you have an efficient rural government?
8. Whether money for roads is being wisely expended in your home district?
9. The efficiency of the rural homes of your district?
10. What part the school has in the life of your community?

References.—Report of the Country Life Commission; Plunkett, The Rural Life Problem in America; Bailey, The Country Life Movement, The State and the Farmer, and The Training of Farmers, three books; Butterfield, Chapters in Rural Progress, and the Country Church and the Rural Problem; Gillett, Rural Constructive Sociology; Fiske, The Challenge of the Country; Davenport, Education for Efficiency; Wilson, The Evolution of the Country Community, and the Church in the Open Country; Israel, The Country Church; Dodd, The Healthful Farmhouse; Farmers' Bulletins No. 185, Beautifying the Home Grounds; No. 270, Modern Conveniences for the Farm Home; No. 347, Repair of Farm Equipment; and Office of Experiment Station, Institute Lectures, No. 8, Farm Architecture, and No. 12, Farm Homes; Annals of the American Academy of Political and Social Science, March, 1912.

Still stands the school-house by the road,
A ragged beggar sunning;

The charcoal frescoes on its wall,
Its door's worn sill, betraying
The feet that, creeping slow to school,
Went storming out to playing!

WHITTIER.

About one-half of the school children of the United States are enrolled in the rural schools, and perhaps ninety per cent of the children of the rural population receive no other education. That the education provided for such children is what it ought to be, or might easily be made to be, few will maintain. Rural children are entitled to something better.—CUBBERLY, in "Rural Life and Education."

If I were to formulate an educational creed for the country school, it would contain but two articles, namely: (1) The country child is entitled to every whit as good an education as that enjoyed by the most favored child attending the American public school; (2) to secure this right for the country child, the country people must expend more money on the country child and expend it in a better way.—KERN, in "Among Country Schools."

CHAPTER XIV

THE RURAL SCHOOL, FESTIVALS, CLUBS, SHORT COURSES, AND CONTINUATION SCHOOLS

The Rural School and Country Life.—Of all of the institutions able to help to make country life attractive, the rural school is the most important. Of course it is the function of the schools everywhere to educate, and the country life problem is largely a problem of education. Then, too, the country school is already on the ground, it is loved by the people, it is the one institution where Catholic and Protestant, Jew and Gentile, Irish and Norwegian, Italian and Quaker may meet and mingle on an equality. The country school has the social machinery with which to make an institution to serve all of the people. There is a County Superintendent whose business it is to superintend the schools in the interests of the country people. Town schools have principals and superintendents of their own. But in order to make the country school an efficient institution for serving the rural people there are at least five things necessary:

1. More money.
2. Better organization, *i.e.,* consolidation.
3. Better supervision.
4. An enriched course of study.
5. Leadership.

This subject of the rural school has, as in the case of the rural life problem, recently called forth a number of very good books. Among these are Cubberley's "Improving Rural Schools," Betts's "New Ideals for Rural Schools," Betts and Hall's "Better Rural Schools," Seeley's "The Country School," Eggleston and Bruere's "The Work of the Rural School," Cubberley's "Rural Life and Education," Carney's "Country Life and the Country School," and Kern's "Among Country Schools." And running through all of these is the demand for more money, better organization, better supervision, an enriched course of study, and leadership to make the rural school an institution for serving the people who support it.

More Money.—Our system of taxation has failed to keep

pace with our growing complex industrial system. The result is that we have new institutions such as railroads and boards of trade which pay proportionately too much of their taxes to the towns and cities. We need a system of support for the rural schools by which the whole state will pay proportionately more but pay according to the use which the rural people make of their school. That is, we need more state money given according to the kind of a teacher that the district hires, according to the attendance, length of term and course of study. For example, a district hiring a teacher certificated to teach agriculture or domestic science, to teach for nine or ten months and to teach twenty to twenty-five pupils, in a school of not more than four grades, should be given more state money than is given to a school hiring an untrained girl to teach for five months in a school of eight grades in one room.

Fig. 127.—A consolidated school is a more efficient institution for serving the people.

Courtesy U. S. Bureau of Education.

Fig. 128.—A western consolidated school.

Fig. 129.—A rural school of old type.

Better Organization — Consolidation.—Country people should have fewer school officers but they should be abler men and women. This will require a school board with power to act for a whole county. This county board should hire

teachers, fix salaries and tax rate, adopt the school books, keep the accounts for the rural schools of the county and supervise the instruction which includes the adopting of the course of study. Subordinate to the county board there may be local boards or directors with power to supervise the building, to act in case of contagious diseases and temporary vacations, and to see to getting such supplies as coal and building equipment.

Gustav Stickley, Architect.

FIG. 130.—The Craftsman Rural Community schoolhouse. This field-stone and stucco building with its pleasant window groups, gables and dormers, has almost a homelike air, and suggests somewhat of the friendly spirit that a community should have. The interior with its provision for practical work in agriculture, carpentry, physics, cooking, and sewing is particularly worth studying, while the big assembly room is intended also for lectures, dances, entertainments, and other social gatherings that will bring together the people of the countryside.—*Craftsman* for September, 1914.

While there will remain some single-roomed schools in out-of-the-way places, yet the consolidated school is the more efficient institution for serving the people (Figs. 127–134). But this does not mean that there are not places where the consolidated school is failing to serve the people as well as are little "chalk-box," single-roomed schools. Burnham in "Two Types of Rural Schools" (Columbia University Studies), tells us that he found consolidated schools costing farmers double as much per pupil and with twice as many pupils behind grade for their

CRAFTSMAN COMMUNITY SCHOOL-HOUSE,

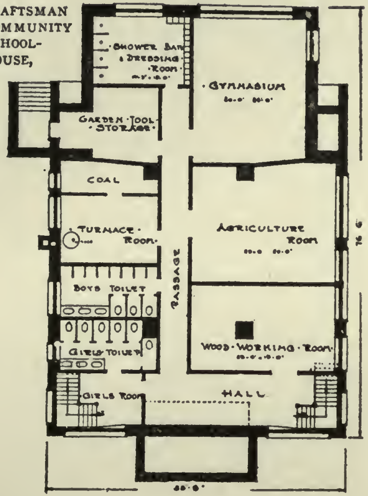
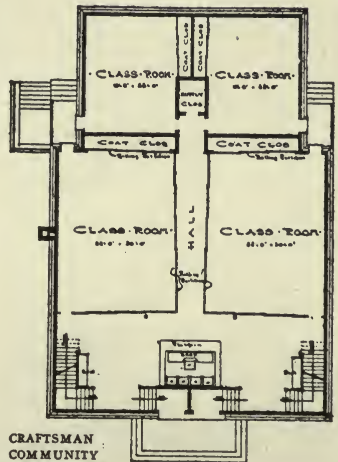
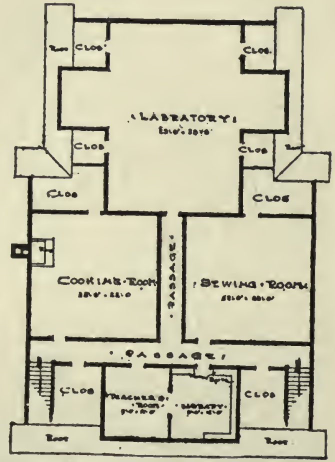


Fig. 131.—Basement plan.



CRAFTSMAN COMMUNITY SCHOOLHOUSE,

Fig. 132.—Main floor.



CRAFTSMAN COMMUNITY SCHOOLHOUSE,

Fig. 133.—Top floor.

Notice that provision is made for a school with an enriched course of study and for a house that may be a rural community center.

age, as he found in typical single-roomed schools in other places. But there are advantages for the consolidated school, and because the people in certain places fail to make it the more efficient school, does not prove that it cannot be made to serve rural people more efficiently. Perhaps the best argument that can be given for the unconsolidated school has been given by Dr. Bailey in the "Farmer and the State." Bailey says: "The present rural schools, with all of their shortcomings, are good schools because (1) they are already in existence, (2) they are schools of all of the people, (3) they are small and thereby likely to be native and simple, (4) they are many and therefore close to actual conditions of the people. I would utilize them to the fullest and in the end these schools, when redirected, will present the solution for the problem of rural education."

Courtesy C. J. Olsen & Sons.

FIG. 134.—School wagon, sanitary, clean, and comfortable.

The advantages claimed for the consolidated schools are:

1. They are the only schools to provide for the education of the older boys and girls, many of whom are sure to be misfits in town schools.

2. They are the only schools to insure an enrolment large enough to justify the hiring of well-trained, capable teachers and to furnish children the social and cultural contact with companionable associates in sufficient numbers.

3. They are the only schools for holding trained teachers and the older and more capable pupils.

4. They are not as expensive for what pupils get from them as are the town schools where farmers must send their older children to school away from home.

5. They are the only schools that provide for transporting the children in wagons driven by men under bond to deliver the children on time, to see that they are dry and comfortable and to see that no improper conversation or conduct takes place on the road to or from school.

6. They may be made the most democratic of rural institutions, that is, the social centre for the community; which means that they may be made to furnish something of interest to every man, woman and child in the community.

Courtesy Southern Cypress Co.
Fig. 135.—Why not a school window like this?

Better Supervision.—Better organization gives us the consolidated school with the county as a unit and this helps wonderfully in solving the problem of better supervision. The consolidated schools have principals who supervise the consolidated school and help supervise the few remaining single-roomed schools as do the best city principals. But we need better county superintendents. We need men and women who understand the rural life problem and who believe that the country schools

are institutions for helping to solve that problem. We need county superintendents who are alert to make the rural schools serve rural people. This may require a new mental attitude toward both the school as an institution and toward what education really is. The county superintendent who can help must be one who believes with Dr. Dewey that education requires "the participation of the individual in the social consciousness of the race." Those interested may well read Dr. Dewey's "My Pedagogical Creed" in order to understand what I am trying to condense into this part of one chapter.

But we have had quite enough of the county superintendents from the town and city schools who are town-minded and who would make of the country schools poor imitations of the poorest town schools. Farmers must be taught to demand county superintendents who are rural-minded, who love the country and who love to serve country people because they are one with them.

An Enriched Course of Study.—This book is the best argument that I can give for an enriched course of study and for teachers to become conscious of what farm life means in education. After all it is largely a matter of mental attitude on the part of the teachers. If teachers do not see the educational possibilities in experiences such as children get in situations like those given in figures 2 and 4 of Chapter I, they are not the teachers to help solve the rural life problem. But if they do see the possibilities for real education, if the teachers are right-minded and willing to help, then they must enrich their course of study by using the materials of interest at home. For starting the work, I know of nothing better than the fall festival.

FESTIVALS

Fall Festivals.—Says King: "The school and educational forces of the community should be brought into correlation. The school, better than any other factor, may become the centre for this correlation" (Fig. 136). Schools and school teachers need the enthusiastic coöperation of the people of the district in order that the children may get from the school all that it is capable of giving. Many teachers are working along with fair success in places where, if they had the enthusiastic coöperation of the patrons, they would be having the very best of success. By that I mean that where there is enthusiasm, pupils learn

more in the same length of time, they retain longer what they learn, they attend more punctually and regularly, and the work is easier for the teacher. One who has observed schools and school teachers for any length of time can duplicate the experience of the young man about whom Superintendent Dutton tells. He was teaching with fair success. There was no community spirit for the school. The teacher had made no use of the press.

Courtesy Victor Talking Machine Co.

Fig. 136.—Rural schools can have as good music as any schools.

A little indiscretion in discipline, and the district was against him. There being no sentiment for him or his work, he was forced, near the middle of the year, to give up the school.

For enabling the teacher to get into touch with the neighborhood, for enabling the school to do something that appeals to the people, I know of nothing more beneficial than the observance of festival occasions. The festival date offers the teacher an opportunity. The festival, if observed by the schools, acts as a unifying influence (Fig. 137). This comes from the fact that parents and friends are welcome visitors to something prepared

by the children for their friends and for the performers there are certain advantages that can hardly come in other ways. Learning takes on a new aspect. Responsibility must be assumed for the occasion; this gives the pupils a new standard. Pupils become conscious of the need of effective communication and this requires clearness in voice, thought and action. If the teacher is tactful, she will see that every one has a part. In order to entertain others, pupils realize that they must prepare.

Corn Festival.—For introducing a rural school to a community, I know of nothing that can be used to better advantage

FIG. 137.—A Wright County, Iowa, fall festival and school exhibit. The tent was used for the school exhibit.

than the Seed Corn Festival. This is not because we wish to make a fad of teaching corn but it is because, as stated in Chapter II, the corn plant means more to farmers than does any other single plant. It is large and beautiful, it is planted before school is out in the spring and it is not harvested until some time after school begins again in the fall. The corn plant is a comparatively new plant and hence tends to vary more than do most other plants. Corn is easily used for decorations. Corn husks may be used instead of raffia to make hats, baskets and other things in the industrial training class. A large number of corn products may be made in the domestic science class. Seed corn should be

gathered about the first week in October. This date is just about long enough after school begins to enable the pupils to feel that they are to have a part in the affairs of the community.

A little of the psychology of farming and of teaching agriculture needs to be comprehended in order to enable a teacher to understand fully the meaning of the Seed Corn Festival. The farmer is an individualist. He works in isolation. He has many things pulling him to be done each day. He is not always wise in his selection of what he is to do. Other things are pressing and he frequently neglects to gather his seed corn until there has been a heavy rain followed by a hard freeze. That means weakened seed, stunted germs, and in return lower yields the following year. Added to that is the fact that if a teacher is to make vocational work popular she must strike from the first on something that is practical, important, and teachable. Gathering seed corn is a farm operation so simple that a child can understand it. All of the members of the family may coöperate in some way to gather and preserve the seed corn. Many of our ablest farmers believe that they add from 20 to 25 bushels to their yields by carefully selecting and preserving their seed the fall before planting. If there is anything a farmer resents it is being taught by a strip of a girl fresh from college. But here is her opportunity. She may make "gathering seed corn" the neighborhood talk for a time. She may get the farmer or his wife, or frequently both of them, together with their neighbors for an afternoon's or evening's entertainment where gathering seed corn is the principal theme. Questions are sure to be asked and the farmer knows it. Hence he gets his seed corn where he may say that it is gathered and safe from cold and storm.

Of this agricultural purpose the teacher needs to be clearly conscious, but she does not need to tell the people that this is her purpose. Nor should it be her only purpose. To get the people together, to enable them to have a good time, to enable her pupils to furnish entertainment, to enable her to meet the people and to enable the people to visit the school for something worth hearing and seeing—these are enough of themselves. But a thoroughly socialized school does more than furnish entertainment for the people—it helps in vital community affairs.

Preparation for the Seed Corn Festival should begin by the announcement that, if the children desire it, such a festival is to

be observed. Then there begins a hunt for appropriate pieces of literature for such an occasion. Books and papers are read. The literature of corn becomes the topic of conversation in the homes. Along with the gathering of literature about corn are gathered songs for the occasion and illustrations of decorations and plays and exercises and uses for corn. In order to get the greatest educational possibilities from a corn festival as from a corn show, it is necessary to illustrate or demonstrate to the visitors the newer and improved methods of handling, planting, grading, estimating, preserving and using corn. The aim is, as near as possible, to have each visitor go from the entertainment saying, "I learned at least one thing that was worth going to see or hear." This means that pupils who do not care to read or who are afraid to recite or sing may be able to do or demonstrate something in connection with corn. For the improved devices and methods they too are to search books, papers and bulletins. Some one should be delegated to call on the implement dealer and ask him to give or lend the school whatever he has that is new and usable such as seed corn graders, seed corn racks and hangers, catalogues, pictures, etc. Though there may not be time to finish them, yet booklets should be started and essays should be in evidence. To have written on it is to understand much more clearly what one is to do in demonstration, recitation or decoration. The teacher must ever keep in mind that art consists in hiding art. Leadership is partly the art of hiding leadership. The festival is the children's, not the teacher's. It is the children's opportunity to serve the community.

Before the festive date arrives each child who is able to write should write an invitation to his parent or the friend whom he wishes to invite. The invitation may read somewhat like this:

Sunnyside School, East Goshen, Pa.

The pupils and teachers of Sunnyside School request the pleasure of your company at their Maize Festival, October 3, 1914, from 3 to 9 P.M.

Sarah Smith.

To Mr. and Mrs. John Smith.

While the invitation is to be somewhat formal, yet it must contain enough so that no one can misunderstand it and so that

the people receiving it feel that it has something of a personal touch to it. It will be noticed that part of the exercises come in the afternoon and part in the evening. Some people object to their children being out in the evenings. Some mothers cannot come in the evenings. Some fathers cannot come in the afternoons. The festival is for all.

The programme should consist of short, crisp, well-rendered selections, recitations, songs, class songs and demonstrations, or what we frequently call "stunts." For this the play on the school grounds needs to have been supervised for some time in preparation for the festival. Exercises in seed corn stringing, in placing kernels of corn in a seed-testing box, in labelling neatly and accurately, in arranging ears to look the best and in other interesting things such as rope tying, setting a table, patching, or sewing, so that when the time comes there will be something of interest to all and so that at odd times, recess and intermission, the teacher may have a three- or four-ring circus going without her having to direct it. And yet with it all and without saying so, the teacher must see to it that the things done are things that the neighborhood needs to know how to do or to do better than they are now being done. (See Frontispiece.)

Christmas Exercises.—Following the Seed Corn Festival, after a reasonable time preparations may begin for the Christmas time. Let the room or the school form a Costless Christmas Association or club, the aim being to see how the members may make appropriate, pretty presents that do not cost money which the members have not earned. Cards, mottoes, blotters, bulletin holders, aprons, handbags and manual training articles of all kinds make interesting work. The important thing for the teacher to do is to find things that are worth while and to see that they are educational. If the festival work leads to a neglect of the common branches there is something wrong with the way the teacher is handling the work. It may be necessary to make the ruling which many of our city schools have, that no one is to take part who is below passing grade or that no one is to take part who is absent except in cases where it is absolutely necessary.

Following Christmas are Lincoln's and Washington's Birthdays, one or two arbor days, May day, class days, graduating exercises, etc. Where the school is a graded school it is some-

times well to let one grade celebrate one day and another grade another day. Then, too, the school should not neglect to help other organizations. I see no reason why a recitation or an essay for a church entertainment should not be prepared at school. The school should do its part in the observance of corn night at the Grange and corn shows. The school should be in evidence at the County Fair and Farmers' Institute. A socialized school is a many-sided school. It is a school in which children live and learn to do by doing, to become a vital part of a neighborhood by being of vital service to that neighborhood. A socialized school is a school in which pupils do things for the sake of the thing done and not necessarily for preparation for something that may never come.

BOYS' AND GIRLS' CLUBS

The Older Boys and Girls.—Rural schools of to-day are very different institutions from those attended by our fathers and grandfathers. When father went to school, the country school was attended by from fifty to eighty pupils and it was taught by a strong intellectual leader. There were no town schools to speak of, and hence the rural schools could hire the best teachers there were to be hired. But now the rural schools are attended by a few small children and they are taught by a girl still in her teens. This gives us the problem of interesting the older boys and girls who should be, but who are not in school. This in turn gave rise to clubs and short courses which we hope will be followed by some kind of continuation schools.

This lack of ability on our part to interest the older boys and girls is a great national loss. We need the consolidated high school, we need good night schools and we need vocational courses for both boys and girls. But these are years off. What are we to do in the meantime? The Boys' and Girls' Clubs seem just now to give us the answer. In 1914 there were over 200,000 of these older boys and girls doing some kind of club work under the direction of the National Department of Agriculture. One thousand boys and girls from the single State of Ohio did something meritorious enough to win a trip to Washington. They were an inspiring group—orderly, happy boys dressed in the khaki of the Boy Scouts and girls dressed plainly but becomingly.

The papers along the way gave accounts of them and for almost the first time in our history the boys in town said, "I wish that I lived in the country where one can do something worth while."

Benefits of Clubs.—In addition to furnishing a substitute for a continuation school for older boys and girls who cannot attend the rural schools, there are other benefits to be derived from the clubs. Boys have the instinctive desire to gang, to belong to something and to do something to attract attention.

FIG. 138.—Canning club girls. A canning demonstration.

These instincts are beneficial if properly guided. But the adolescent instinct, unguided, often leads to acts which would not have been committed had there been something else to do.

Girls like to belong to cliques and this, too, is a wholesome feeling if properly guided. Both of the instincts, to "gang" and to "clique," are social instincts which need to be exercised in order to develop social beings. The teacher needs to get the larger vision and think of the school campus as the whole district and the pupils as all of the people of the district. Her life will be happier if she is of real service to all.

The practical or economic value of the club is not to be overlooked. Mr. O. H. Benson, of the U. S. Department of Agriculture, has repeatedly taught 14-year-old girls to can 300 quarts of garden truck in a day. This is done with a little eight-dollar outfit (Fig. 38) which may be bought on the coöperative plan and used by three or more families. There is no good reason why the overburdened mother should stew and fret all summer in order to can 100 quarts for her winter use. Half of the garden truck in the country goes to waste, half of the girls wish they had some way to earn spending money, and half of the people of the nation go hungry for garden vegetables during the winter months. The clubs are the places where we may bring these forces together (Fig. 138).

The economic benefits of the boys' clubs are equal to those of the girls'. Little Leroy Nichols of Highland, Maryland, raised 150 bushels of corn on one acre at a cost of thirteen cents a bushel. He did that at a time when the average American farmer was growing about 29 bushels to an acre at a cost of something near forty-four cents per bushel. Earl Zeller of Iowa, the same year, grew 146 bushels on his acre and grew them at a cost of nine and a fraction cents per bushel. This was done at a time when Iowa farmers were growing 43 bushels on an acre at a cost of some forty or more cents per bushel. As stated in Chapter II, those who belong to the clubs are privileged to use a label for their produce which enables them to guarantee to the buyer that it is of first-class quality, and this in turn enables them to get a much better price for what they have to sell.

Those who love rites, mysteries and ceremonies may wear a badge which means fully as much as the boy scout badge. One boy said that he could not see that a club member was any better than any one else. " Well," said the member, " they try to be good " (Fig. 37).

The background of the badge is a book which stands for knowledge. On the book is a four-leafed clover which stands for good luck and the fertility of the soil and on the clover is a kernel of corn or symbol of what the club member is trying to produce. In each of the four leaflets of the clover is an " H," these four " H's " stand for health, hand, head and heart dedicated to human service. If the member is in the age where rites and mysteries appeal to him he will be happy to learn that the

badge has yet more meaning. The four "H's" stand for a four-square life and each "H" has in it a trinity so that the four mean: Train the—

Health	Head
To resist disease.	To plan.
To enjoy life.	To think.
To make for efficiency.	To reason.

Hand	Heart
To be useful.	To be true.
To be helpful.	To be kind.
To be skilful.	To be sympathetic.

Nor does the meaning of the badge stop there. Each badge has on it the word DEMONSTRATOR, which means that the club member is a demonstrator to the world as to what we can do in America with scientific agriculture. This demonstrating appeals to the adolescent. But added to these uses of the badge is the fact that it is a part of a trade mark which the members are permitted to use on their goods for the market. (See Fig. 18, Chapter II.)

In the national contests, the members are marked as follows:

Boys' Corn Club

Age: 10 to 18 years, inclusive.
Acreage: One acre.
Basis of award:

1. Greatest yield per acre	30
2. Best showing of profit on investment	30
3. Best exhibit of ten ears at county, district, and State fairs	20
4. Best written history entitled "How I Made My Crop of Corn"	20
Total score	100

Girls' Garden and Canning Club

Age: 10 to 18 years, inclusive.
Acreage: One-tenth acre, chiefly tomatoes. A few other vegetables. Club members required to can surplus products.
Basis of award:

1. Quality	20
2. Quantity (total pounds of vegetables harvested and used)	20
3. Variety of canned products	20
4. Profit on investment	20
5. Written history on "How I Made My Tomato Crop"	20
Total score	100

Boys' and Girls' Potato Club

Age: 10 to 18 years, inclusive.
Acreage: One-eighth acre.
Basis of award:

1. Greatest yield per one-eighth acre	40
2. Best showing of profit on investment	30
3. Best exhibit of one peck of seed potatoes	15
4. Best history on "How I Made My Crop of Potatoes"	15
Total score	100

How may a teacher form a boys' or girls' club? That is easy; no long catechism or constitution is required, though a short constitution is convenient. Write to your Farm Bureau agent, to your State College or to the United States Department of Agriculture for instructions. Each teacher will receive enrolling cards or sheets for those who may wish to become members. These, when filled in and returned to headquarters, are followed by sheets giving instructions as to what to do, how to select and prepare the soil, about when to plant, how to get and test good seed, etc. This page when filled in and returned is followed by another and then another giving the things to do and the records to keep for the season's work.

The personal touch and association should not be underestimated and hence the teacher, when possible to do so, should have a club leader come to her school and talk to the children about the club work and its pleasures and benefits. Here again the teacher who is socializing her school recognizes the educational waste that comes when such a person talks to a few small children only. For that occasion the teacher should invite all interested parties, including the parents, but giving especially urgent invitations to the older boys and girls who are not in school.

The line of work to be undertaken must be considered carefully. Then the question of how many clubs, whether one for both boys and girls or one for boys and one for girls, must be decided. As a rule it is better to let adolescent boys have a club of their own and adolescent girls have a club of their own. If they are to use the school-house they may meet on alternate weeks, or the girls on Wednesdays and the boys on Fridays. For young people about the age of twenty years or older, it is well to have one club and have two or three programmes. Let them meet, say, at eight o'clock. The boys are to discuss for three-

quarters of an hour how to grow, judge, select breed or do something with corn; while the girls discuss how to grow, can or handle tomatoes (Fig. 138). Then a short joint meeting, a short social visit, and the meeting is over. The separate programmes are carried on as are our Sunday School classes. Leaders need to be cautioned about keeping late hours. There should be a definite time agreed upon to close and that time should be adhered to closely.

Then, too, the leader must see to it that there is the same enthusiasm put into the study programmes and lessons that there is into the social and literary exercises. If this is not attended to, the better members will begin to drop out. Farm folk are great folk to like to listen to people who have done things. It is wise to invite the successful in the given line to address the club. The best corn grower, the one who has won, is the logical leader. If you cannot have the successful ones actually present, get some good reader to read an account of what they did and then have that account discussed. The teacher needs to keep on file such accounts and have them ready to supply at times when other material for lessons and programmes is short.

Each member must have something to do. The bashful members are frequently helped by having a roll call of short accounts, items from the papers or quotations on the subject. This leads to reading on the part of every member. A good leader is one who does not do all of the talking. A good leader is one who has a good imagination and hence sees very clearly the meaning of all that is being done. There are many cultured men and women in the rural districts whose talent is not being used by the community. The situation needs a teacher who is an organizer and who can conserve this social heritage.

Perhaps a description of a corn club in Iowa will give the reader an idea of what one is. This club was formed by the young people of the neighborhood. They met at each other's houses, both boys and girls attending. The boys met in one room for their study and the girls in another. Then they had the literary meeting in a room where both met. They had singing, speaking, quotations and whatever seemed pleasing and helpful. The name of the club is the "Evergreen Club," but the members were not evergreen. The boys were principally interested in corn and grain breeding. The first time they took their corn to the

State College show it was so poor that the boys decided not to open their boxes. That was a lesson for green country boys. An educated individual is one who, among other things, takes defeat helpfully and cheerfully. The boys made up their minds then and there that they would take home some good seed corn. They bought the best to be had and three years afterward it took a railroad car to carry home their prizes. One of them became the State champion corn judge, a number of them won State championships for their ears of corn during different years and at different shows. Among their prizes were three $150 manure spreaders. They became noted for their good seed corn and that has brought hundreds of dollars to the community, for there were enough of them growing good corn so that a buyer is almost certain to have his orders filled. If the one to whom the order is sent does not have the seed, a fellow club member is sure to have it.

Then, too, the very existence of the club enabled the members to lay hold of and use much talent that would otherwise be lost to them. If a young person is home for vacation from college, he is asked to give an account of what he has learned that is worth while for that neighborhood. If the district is visited by a writer, preacher or educator they manage to use him for an evening. It does not matter if few are present or that a speaker cannot be present at regular meetings. The neighborhood is hungry, as it were, for entertainment, and talent is going to waste. What is needed is an organization to conserve and disseminate the best that there is. This makes success surer and life mean more.

As was to be expected, the good influence of the "Evergreen Club" did not stop with the growing of better corn and the cooking of better things to eat. That neighborhood was noted for the number of young men and women who went from it to college. Some of them returned to be life-workers in the district. Others became noted rural social-service workers. Fred Hanson is widely known for the work he has done organizing rural Y. M. C. A.'s. His good influence is felt in rural districts all over the United States. Perhaps this is the place to say that we have no thought by introducing agriculture and domestic science in the schools, by having boys work in corn, poultry or potato clubs, to keep all boys on the farm. We do not wish all

boys to stay on the farm, but we do wish first of all to have those stay who have strength and talent for farming, we wish to have others awakened to the need of social-service workers for the rural districts, and we wish to enable the country to furnish its fair share of leaders for the cities, but leaders who understand the double problem of coöperation between town and country. We want strong young people who go to the cities and there become leaders who understand that the cities dare not prosper at the expense of the country, materially or morally.

The County Fair.—Two institutions are frequently ignored by the schools, and yet each is capable of doing much more than it is now doing for both the school and the community. These are the County or District Fair and the Farmers' Institute. The schools should be in evidence at the fairs. Teachers should help to mould a healthy public opinion for a clean, educational fair. A teacher has not done all of his duty when he has given the children one day of vacation to visit the fair. There will be exhibits at the fair. The pupils should discuss the relative merits of what is to be exhibited there. The pupils should have enough drill in the use of the various score cards to enable them to go to the fair and to see critically while there. To-day the club members alone are getting this drill. The vaudeville features are to disappear when the schools have taught the people to demand something better. To-day the agricultural press is almost the only institution that stands for a clean fair. To be sure the minister preaches for a clean fair, but he does not preach to those who are demanding the gambling and other questionable entertainment. Our schools should have attractive exhibits of things that are interesting to those who wish to learn of agriculture, and our schools should help to create a demand in every department for a clean, helpful exhibit.

The Farmers' Institute.—Another great educational institution often ignored by the schools is the Farmers' Institute. Here is an institution costing about twice as much for running expenses as any American university, and attended by more than ten times as many people. Frequently there are exhibits of the highest value. There are programmes where pupils may help both to entertain and to instruct. If the teacher does his duty by his pupils, he will see that they have a part in the Farmers' Institute. In Delaware, for illustration, Dr. Wagner, Com-

missioner of Education, had the schools closed for one half-day and the older pupils taken to the Institute. The pupils knew that the next day they would be required to give written reports of what was said and hence they went with paper and pencils and were interested listeners. Of course, where such a thing is to be done, it is the duty of the teacher to ask the officers of the Institute to have at least one topic and one speaker to interest the pupils. An account of the boys' and girls' club work is always interesting to both pupils and older people. In many places where the clubs are strong, there is a separate programme for the club members and to this the pupils of the schools may go and while there get inspiration to do things. But the Farmers' Institutes are too generally held in town. We need first-class institutes in the country. The specialists should go to the farmer and not ask the farmer to come to town. Any wideawake teacher can have an institute for at least one day and one evening. She has talent enough in her district for that. But Farmers' Institute workers must remember that farm folk demand for speakers people who are known to have done things worth while. If you want to kill an institute, have men talk who have never done anything but talk.

NIGHT SCHOOLS

Night Schools for the Older Boys and Girls.—Helping the older boys and girls is a matter of too much importance to be left to anything so transient as fairs and institutes or to clubs and short courses. It is a matter of importance enough to justify the expenditure of some money and the organization of institutions to supply the need. But until school boards and officers are able to see this, the teacher who has the social point of view may have to organize night schools. If she is able, she may run the night school. If necessary she may hire help for part of the work. Let the board grant the use of the building and let it be properly equipped with lights, seats, etc. Then let the teacher organize the night classes, charging each member one or two dollars for twelve to twenty lessons. The meetings may be twice a week or oftener as desired. But the course must be a live one with something of vital interest, and presented in a concrete, vital way.

The course may include penmanship, business forms, letter writing, farm bookkeeping, farm management problems and

agriculture and domestic science, with material so selected as to be of interest to both sexes. The agriculture may be taught by a young farmer who is a graduate of some good agricultural college. There should be close correlation between the writing and the other studies. Pupils should write because they have something to say and not because they have to say something.

Continuation Schools.—There is great need that these schools be made permanent and supported by the regular school funds. That means regular continuation schools for the older pupils. At least one of these schools should be held in each township. In these schools the boy or girl who is too old to attend the regular school should be able to take the subjects in which he is interested. Democracy dares not do less, for it needs the wisest of public opinion on the most varied of subjects. Then, too, as Dr. Seerly says: "Country pupils are as capable of learning history, science, mathematics, music and art as are city pupils. They have just as much hunger for the intellectual and the instructional, for the profound and the philosophical, for the national and the world type, for the artistic and the sublime because their world of experience is even broader and deeper and more normal than the majority of those that live among the experiences that are man-made and thereby conventional and artificial."

Continuation Schools in Consolidated Schools.—Of course the proper place to carry on this work of the night school and the broader courses of the continuation school is in the consolidated school. There we can have a building large enough, there we can have teachers with talents differing enough, there we can have the community centre and the prestige that makes the work mean the most, but the road to the consolidated school is over the path that makes the little chalk-box school-house too small to hold the varied activities that are clamoring to enter. And until teachers make more use of what they already have, I am not sure that boards are justified in making much larger expenditures.

This makes it necessary to say that, in most places where I have observed, the teacher and the so-called educator are the main blocks in the way of better rural schools. Teachers are burdened with tradition. They do not know how to teach without books. They cannot see how culture can come through vocational subjects. They want to teach pupils to study, while the nation

wants them taught to work. They cannot see how one can teach lessons from plants, cows, horses, hen houses and eggs. They do not know how to make culture come through agriculture.

The Short Course.—For helping the teachers, for waking up the young people of a district, for putting new life and enthusiasm into work on the farms, I know of nothing so helpful as the short courses run for a week by the State College men coöperating with the Farm Bureau agent. These people know how to teach from things. They know how to make corn so interesting that old men run from building to building in order not to miss any of the next recitation. They know how to run a new kind of a school where people are seated best on seats that cannot be screwed down, where teachers do not use books, where pupils are not necessarily required to read and where things are done and lessons taught by doing. All of this is so strange and foreign to the school teacher of to-day that he must go to one or more of these short courses in order to understand them. But they offer the leaven, and when once they are held in a township that leaven is very sure to enter the elementary grades.

Nor is it as hard to get up one of these short courses as some people think. The claim that we cannot teach agriculture without thousands of dollars worth of equipment is made by men from big colleges, to advertise their colleges. Every farm is a demonstration farm with much valuable equipment. Poor stock are as necessary for teaching as good stock. There are farmers who are willing to lend some of their poorest animals to be shown as specimens of what a farmer should not keep. There are horsemen and cattlemen with good animals who are willing to bring them to the school for the few hours that they are needed. At times the class can visit the nearby farms. There is quite as much danger that we will teach domestic science with an equipment far above any the girls will find at home as that we shall have to teach the subject with too little equipment.

In Wright County, Iowa, the Farm Bureau agent, coöperating with the County Superintendent, held a short course in each township. The farmers were glad to attend. Mr. Wise of the Farm Bureau well says: "To ask farmers to go to State College is to reach only a very small per cent. We are going to have so many courses that there will not be a man or woman, or boy or girl in the county who has an excuse for not attending." And

what do they do at those Short Courses? Let the Farm Bureau agent tell us. He writes as follows: "I am holding a three days' Short Course in every township in Wright County. In the morning we get together at the central school-house for a study of grains, grasses and soils. In the afternoon we go to some farmers' lots where cattle, horses and hogs are judged and discussion given concerning the method of feeding and care of live stock. In the evening we meet at the central school-house. The first evening I give a lecture on 'Conformation of Live Stock, Desirable from the Market Standpoint.' The second evening County Superintendent Howell lectures on 'A Better Country School.' The third evening we have an old-fashioned spelling match and basket social. In townships where there is no country club organization we have so far succeeded in organizing either a Debating Society or an Agricultural Improvement Club. After spending three days in a township we find the people willing to get together for some kind of a country organization. Our plan is to organize in every township an Improvement Club and then get representatives."

Tests for Agricultural Education.—Agricultural education, in order to become permanently popular, must not neglect any one of the three essentials for vocational education. There must at all times be Principles, Practice and Profits, some say the three R's—Rules, Reasoning, and Results. Educators generally prefer Discipline, Usefulness, and Culture. The problem in agricultural education is the same as the problem in industrial education everywhere, that is, to have a school that is more than a laboratory and to have work at home that is closely correlated with the school work. Laboratory scientists are very useful men, but they are not vocational teachers. On the other hand, the farmer cannot and will not teach his boy so that the boy gets the principles and culture which the farm is capable of giving.

Whether agriculture and domestic science in the school be cultural or not depends upon the teacher. If, when the child mind comes to a project, that mind is led to go back and get the historic setting, if it goes outward and gets the human meaning of the project and its relation to the great world of which it is a small part, then there is culture in it. To illustrate, if one has the growing of a patch of alfalfa, the home project has for an aim to teach the principles, to get the boy to do the work and

to get the alfalfa grown in such a way that if farmers do the same there will be profit in it. But it is very easy for the teacher to require, as part of the work, the history of the alfalfa plant, the human meaning of the plant where it has been successfully grown, what may happen if the people of the district fail to learn to grow alfalfa successfully, and what are the chances for a wider use of the alfalfa plant. The same line of topics does for corn, tomatoes, better potatoes, better poultry or almost any project that a boy may undertake. The history of the machinery that has been made in order to handle the wheat, or the history of one single machine, the plow, gives culture of the highest value. Some one has said that education is teaching us to see the much in the little. The plow is a very ordinary looking implement and yet few machines have had as much thought put on them. Jefferson worked for years to make the plow a little nearer perfect. Summing this up, we say that the farmers will demand of agriculture the three P's—Principles, Practice and Profits, and the educators will demand Discipline, Usefulness and Culture, and unless a teacher or school has all it may expect to fail in the work of teaching agriculture.

Rural Social Surveys.—Rural social surveys are needed everywhere and these make vital work for the spare time of the instructor during the summer months. The country people need an inventory of their possible social and economic resources. What have they of unused possibilities? What of their unused economic possibilities? How may life be made to mean more, to be richer? Perhaps the Georgia Normal plan, if used in coöperation with a nearby college or university, is the most feasible plan. The professor of social or economic science outlines and supervises the survey work. The local instructor or teacher fills in the outlines, submits them to leading people of the district, and they discuss them. The report or survey inventory is sent to the college or university for interpretation, after which a revised survey report or survey inventory becomes the public property of the district. This makes the work impersonal. If hard things are said, if defects and shortcomings are made public, no one person is to bear the blame. The teacher especially is free and the head of the department in the college or university may well bear the opprobrium for the good of the cause.

The social surveys made by Cornell University, by the University of Wisconsin and the University of Minnesota are certainly very helpful. The social survey work as done by the Normal School at Athens, Georgia, and that done by the Presbyterian Church from New York are also helpful. The United States Department of Agriculture is carrying on a very extensive series of soil surveys. These need to be obtained for the school library as a basis of the work. Geology, geography, economics, sociology and agriculture are to go to the country together to be of service to those who need them. Mr. George A. Billings, of the Bureau of Farm Management at Washington, is making extensive labor schedule surveys and remapping surveys, which should become a part of the school libraries in agricultural districts.

The literature of surveys is not yet large. We have "The Survey Idea in Country Life Work," by L. H. Bailey; "A Rural Survey in Missouri" and "A Rural Survey in Indiana," published by the Presbyterian Home Missionary Board; "A Method of Making a Social Survey," by C. J. Galpin, University of Wisconsin; "Social and Economic Survey in a Rural Township," by Thompson and Warber, University of Minnesota Studies; "An Agricultural Survey of Tompkins County, New York," Cornell University; "An Educational Survey of Montgomery County, Md.," United States Bureau of Education Bulletin No. 32, 1913. Chapter II of Eggleston and Burère's "The Work of the Rural School" is on "The Community Survey," and in that we read:

"Before a school program is drafted, and where possible before the site is chosen, before the building or buildings are erected, before the school-plant is equipped, the school authorities should make a community survey to find out what the prevailing aspirations of the community are, to discover its economic and social resources and possibilities, its deficiencies and needs. Upon the facts brought to light by the survey, an economic and social program for the entire community should be based, and the school program must be developed as to the central part of the community program.

"No rigid rules can be laid down as to the manner in which a survey should be made. There will be as many different sets of conditions as there are communities. But whether the leading activity of the community is truck-farming, or fruit-growing, or

the raising of corn or wheat or cattle or dairy products, the underlying purpose of the survey remains the same. Whatever the distinctive business of the community may be, it is the business of the teacher and the principal and the superintendent to understand that business and all of the related factors that make for or against community happiness and prosperity. The extent of the general and school population, the sanitary conditions in the individual homes and the district, the prevailing methods of home and farm management, the facilities for intercommunication—roads, telephones, mail service and the like—the ownership of the land, the extent of tenant-farming, in short, all the facts that have a vital bearing upon community life, are essential to the adjustment of the work of the school to the economic and spiritual needs of the community."

Rural Life Leadership.—The Country Life Commission, whose report is yet the best thing that we have on our rural life problem, says, "We must picture to ourselves a new rural social structure, developed from the resident forces of the open country; and then we must set at work all of the agencies that will tend to bring this about. The entire people need to be aroused to this avenue to usefulness. Most of the new leaders must be the farmers. . . . A new race of teachers must also appear in the country. A new rural clergy is to be trained. These leaders will see the great underlying problems of country life and together they will work, each in his own field, for the one goal of a new and a permanent rural civilization."

And the report says in regard to education: "The subject of paramount importance . . . is education. In every part of the United States there seems to be one mind, on the part of those capable of judging, on the necessity of redirecting the rural schools. There is no such unanimity on any other subject. . . . Everywhere there is a demand that education have relation to living, that the schools should express the daily life, and that in the rural districts they should educate by means of agriculture and country life subjects. . . . The schools are held to be responsible for ineffective farming, lack of ideals, and drift to town. This is not so because the rural schools are declining but because they are in a state of arrested development. . . . It is difficult to make people understand what this really means, for school-teaching is burdened with tradition."

The country school needs men and women of vision, " who see through the incidental, the small and the transient, to the fundamental." The country school needs men who are practical, who know practical farming and with it how to live. The country school needs men who have originality and with it a philosophic understanding of what is fundamental and abiding. The country school wants men who dare break with tradition. It wants county superintendents who can be kind and yet original, who can break with tradition and yet not offend those who fear to see it done.

The rural schools need teachers with new ideals. If teachers are optimists or pessimists or evolutionists of the nineteenth century school, they are apt to say nothing can be done and drift with the times; but if teachers are meliorists they say that things are not wholly bad nor wholly good and it is possible by the use of intellect to see how to make things considerably better. If teachers have achievement as an ideal and make knowledge a means to an end, then they are ready to help make the " better best and the best better."

In addition to the Country Life Commission and the splendid report made by it, our need for rural life leaders has called forth among others such books as Fiske's " Challenge of the Country," and Anderson's " The Farmer of To-morrow." In many ways, as Fiske points out, the rural life problem of to-day is challenging the young men and women of our colleges. But they are only beginning to study the problem, it is so big and so varied, there is so much to do, and a strong, vigorous people are so necessary to the national welfare, that there is a chance for many more than are now entering the field of leadership. When we become conscious of all that agriculture can do for the development of a noble man or woman, when we become conscious of how necessary it is to maintain a standard people in the open country, when we become conscious of the strategic position of the rural schools, we cannot think of education as anything less than giving one his racial inheritance so that he may be better adjusted and of more efficient service to his fellow members of human society. Dr. Bailey has given us an ideal for the real husbandman who is both a good farmer and a rural life leader. In substance he says:

The real husbandman is efficient in four ways: Ability to make a full and comfortable living from the farm. Ability to leave the farm better than he found it. Ability to be of service to the community. Ability to rear a family carefully and well.

QUESTIONS AND STUDIES

What have you learned about:

1. How we may improve rural schools?
2. How festivals may help solve the rural life problem?
3. Boys' and Girls' Clubs and how they may help?
4. How night schools may be conducted?
5. How short courses and continuation schools may help?
6. What are the best tests for agricultural education?
7. Where are leaders needed?

What can you learn about:

8. An efficient rural school near your home?
9. What Boys' and Girls' Clubs are doing in your district?
10. The work of some rural life leader?

References.—Betts' and Hall's Better Rural Schools; Carney, Country Life and the Country School; Cubberley, Rural Life and Education; Hockenberry, Rural Schools; Fought, The American Rural School; Eggleston and Bruère, The Work of the Rural School; Seerley, The Country School; McKeever, Farm Boys and Girls; Cubberley, Improving Rural Schools; Betts, New Ideals for Rural Schools; Snedden, The Problem of Vocational Education; Bloomfield, The Vocational Guidance of Youth; Puffer, Vocational Guidance; Farmers' Bulletin No. 385, Boys' and Girls' Clubs; No. 562. Organization of Boys' and Girls' Poultry Clubs; Iowa Circular 18, Boys' and Girls' Pig Contests; 67 C, Boys' and Girls' Manual Training; Kern, Among Country Schools; Field, The Corn Lady; Bureau of Plant Industry Circular No. 104, Special Contests for Corn Club Work; Bureau of Animal Industry Circular No. 208, Organization of Girls' Poultry Clubs; Stern, Neighborhood Entertainment; Curtis, Play and Recreation for the Open Country; Bailey, The Training of Farmers; Cyclopedia of Agriculture; King, Social Aspect of Education, also Education for Social Efficiency; Cutler and Stone, The Rural School.

Agriculture must first be taught by effective correlation, then by general lessons and in daily class work. The Corn Club Demonstration plats should be the agricultural laboratory of the rural and village school. There is quite as much education and true learning in the analysis of an ear of corn as in the analysis of a complex sentence; ability to analyze clover and alfalfa roots savors of quite as much culture as does the study of Latin and Greek roots. Our education must conserve equally well the training of head, hands, health, and heart, and therefore the truly educated must be four square. The national government will need to plan definitely for the reclamation of the arid interests of our American farmers, who have become dead to light and knowledge and slaves to old-time methods. Instead of the criminal exploitation of wars and bloodshed in the United States history, let us substitute the study of our national agriculture and the captains of our national industries.—O. H. Benson.

It is noticeable that confusion in failure to discriminate clearly between agricultural education and rural education still exists. The notion of education in the rural districts is, traditionally, that of preparation for life which enables the farmer's boy or girl to make a living in the city. . . . As in former meetings the training of teachers brought out the most discussion. It was almost grotesque to listen to the proposals to make out of a city girl a successful teacher in the rural districts. One speaker most forcibly brought forward the point that agricultural education can be taught successfully only by men.—*Report of the 1914 National Educational Association.*

CHAPTER XV

COURSES OF STUDY, CORRELATIONS, BOOKLETS, LESSON PLANS, TABLES, ETC.

Course 1, for Ungraded Schools.—By using the upper line of the following, for the first year, and the lower, for the second year, we have a two years' course. If there is no room for agriculture in the overcrowded program, make room by having advanced geography three times a week and grammar four times; that leaves three periods per week for the agriculture. Notice that the subjects in the following courses follow the seasonal sequence. Correlate the agriculture with geography, drawing, English, arithmetic, and spelling.

September and October

Seed Selection, Insects, Birds, Weeds.
The Plant, Plant Breeding, especially Hill Selection of Seed Potatoes.

November and December

Housing Farm Crops and Animals, Feeds and Feeding.
Stock Judging, Grain Judging, Fitting Corn for Shows.

January and February

Care of Farm Animals, Ventilation, Dairying.
Farm Accounts, Farm Machinery, Seed Testing and Analysis.

March and April

Field Management, Crop Rotations, Drainage.
Soils, Conservation of Moisture, Fertilizers, Landscaping, Birds, Weeds.

May and June

Planting and Cultivating, Farm Crops, Poultry, especially Care of Young.
Flies and Mosquitoes, Gardening, Fruit Growing, Insects.

Course 2, for Small High Schools.—This course is taken from Bulletin No. 20 (1912), U. S. Bureau of Education. Studies are five hours each week unless otherwise designated. For practicums or home projects, see Course 3.

First Year

English.
Advanced Arithmetic.
Agronomy.
Farm Machinery, Farm Carpentry (ten hours).

Second Year

English.
Practical Mathematics.
Animal Husbandry, and Dairying.
Farm Mechanics—Blacksmithing (ten hours).

Third Year

English.
Physics.
Horticulture.
Road Building (one-half year).
Forestry (one-half year).

Fourth Year

English.
American Constitutional History (four hours).
Rural Economics and Farm Management (four hours).
Physiology, Geology, and Mineralogy (four hours).

Course 3, for a First-class High School.—This course to be elective instead of the Scientific or College Preparatory. For girls not intending to teach in rural schools, substitute domestic science for agriculture.

By practicums we mean home projects or work done at home, under the direction of the school, the State or United States club leader, the local Farm Bureau or some other organization. Reading, reports, and experience should form a part of the class work. For correlations, see the outlines following, in this chapter.

First Year

First half	Second half
Mathematics—High School Bookkeeping	Mathematics—High School Arithmetic
English—Grammar and Composition	English—Grammar and Composition
Drills—Drawing, Music, Writing, Spelling	Drills—Drawing, Music, Writing, Spelling
Science—Botany	Science—Physical Geography
Agriculture—Agronomy	Agriculture—Agronomy and Soils
Practicums—Gathering seeds, especially hill selection of potatoes and corn, selecting and judging corn for and at shows.	Practicums—Mapping of fields, starting rotations, making a set of books, records, inventory, etc., for the farm.

Second Year

Mathematics—High School Algebra	Mathematics—High School Algebra
English—Composition and Classics	English—Composition and Classics
Drills—Drawing, Writing, Music, Spelling	Drills—Drawing, Music, Writing, Spelling
Science—Zoology	Science—Physiology
Agriculture—Animal Husbandry	Agriculture — Animal Husbandry and Dairying
Practicums—Housing farm animals, ventilating and lighting farm buildings.	Practicums—Feeds and feeding, care of animals, milking and care of milk, keeping milk records and testing cows.

Third Year

Mathematics—Plane Geometry	Mathematics—Plane Geometry
English—Composition and English Literature	English—Composition and English Literature
History—Ancient	History—Modern.
Drills—Drawing, Writing and Music	Drills—Drawing, Writing and Music
Science—Physics	Science—Physics of Agriculture
Agriculture — Horticulture and Road-making	Agriculture—Horticulture and Forestry
Practicums—Road-making, especially work with the King road drag, budding and grafting, mound layering, propagating by cuttings, transplanting.	Practicums—Use of road drag, trimming, tree doctoring, transplanting, spraying.

Fourth Year

Mathematics—Solid Geometry	Mathematics—Trigonometry and Surveying
English—American Literature and Rhetoric	English—American Literature and Rhetoric
History—American	History—American Constitutional and Civics
Science—Chemistry	Science—Chemistry of Agriculture and Sanitation
Agriculture—Farm Management	Agriculture—Rural Economics and Sociology
Practicums—Improvement of arrangement of fields, improvement of labor schedules, introduction of paying lines.	Practicums—Help in country church, grange, club, or rural government, making a set of books that show labor distribution, profits, superior management, etc.

How to Begin Agriculture.—"But how shall I begin the work in agriculture?" asks the teacher. I answer, since school generally begins in September and since that month is *par excellence* the month for selecting and gathering seeds, it would be a good plan to begin by having the pupils make collections of seeds. We must remember that the child's natural tendencies to make collections begins about the seventh year and reaches its height about the twelfth year. That being true, the greatest natural tendency to make collections we would expect to find in the grades from the second to the sixth or eighth. But the older children are also interested in gathering seeds in September and October, that is one of the home activities. It is a good plan to have one grade collect seeds, another insects, another fruits, another nuts, minerals, soils, pictures of different breeds of animals, leaves, disease spots, etc. These will be needed later in the year when specimens are hard to find. If these things,

especially insects, plant diseases, heads of grains and grasses, etc., are mounted in the Riker specimen mounts or school-made mounts of glass, strips of thin boards and passe-partout. Some teachers have correlated the work with geography by having the pupils take a large map of the United States and glue, paste or paint a sample of each product on the states where produced. These collections make an interesting way to introduce agriculture and they may become an organic part of the school equipment and illustrate things in arithmetic, geography, and elementary science. (See Farmers' Bulletin No. 586, U. S. Department of Agriculture, "Collecting and Preserving Material for the Study of Agriculture.")

CORRELATION WORK FOR RURAL AND GRADED SCHOOLS *

Some Principles.—There are principles some of which should govern us when selecting material to teach in agriculture. Among these principles are the facts that there is more than we can hope to teach, the work should have seasonal sequence—that is, follow the dominant home interests; we must treat local practices with respect but try to change them where we know of something better; we must not spend too much time on agriculture to the neglect of other branches or there will be a reaction against agriculture in the schools; we must make the agriculture help the other branches, hence the need for correlation work. There are yet other principles to keep in mind, one of which is that we should be sure to teach something well worth while and not waste the pupil's time on the useless. We should emphasize mostly those things which the pupil is least likely to learn at home. We should make the work advanced enough to keep the pupil a "little on the stretch," as the psychologist would say. We should be keenly conscious that there is a body of knowledge that has both cultural and educative value and that is well worth while conveying to the pupils in rural districts. This knowledge is growing faster than we are likely to find ways of conveying it.

Supplementary Reading.—For supplementary reading use State and United States bulletins. Have pupils read for the thought on the printed page. Have them make both oral and written reports. Have them learn poems relating to the agricul-

* Adapted from Iowa Bulletin, Vol. XII, No. 8.

tural subjects. Let them read those parts of books treating on the topics under discussion. A list of over 600 Farmers' Bulletins can be obtained from your Congressman. The school library should be reasonably well filled with some of the splendid books now so rapidly appearing on every phase of rural life and agriculture.

Grammar and Composition.—Have oral discussions of field trips. Write neat reports. Save some of the better pages for "Booklets." Have pupils make booklets on the more important subjects. Pay particular attention to neatness, spelling, grammar, punctuation, capitalization, paragraphing, etc. Take time to call attention to new words when introduced. Have pupils write and pronounce each. If known, give the origin of the word and by analysis show its meaning.

Arithmetic.—Have the pupils or board get, for each pupil, a yard measure. They are frequently given away by merchants for advertising. Measure fields, buildings, bins, hay stacks, cribs, yards, posts, distance between posts, etc. Calculate costs, capacities, values, etc. Supplement arithmetic with problems that are coming up at home. Let each pupil bring from home one or more problems to supplement the part of the arithmetic being studied. Collect problems on farm management. Have a scrap-book and collect problems from questions asked in agricultural papers. Use figures that represent real farm conditions. (See Jessie Field's Farm Arithmetic, Burkett and Swartzel's Farm Arithmetic or Lewis's Farm Arithmetic.)

Home Geography.—Geography of the school district, latitude and its connection with the crops being grown, weather and its influence on agriculture, climate as affecting what can and cannot be grown, number of days' work in a year, profits from certain lines. Why do or do we not grow cotton, rice, tobacco, wheat, fruit, or other special crops? Discuss other groups of states as desirable places in which to farm. For advanced pupils, use farm score card and home score card to score states and homes and then other states for comparison.

History and Civics.—Study the relation of industries and inventions in the development of the country. Have pupils make, as part of booklet work, historical studies of various crops, animals, and plants in the district. Search to find origin, influence, and historic causes of crops and animals. What fruits,

varieties of corn, hogs, cattle, chickens, etc., originated near or in the district. Make a study of transportation, history, problems, etc. Make a study of history and influence of good roads. Study road laws, weed laws, and land surveys, study history and influence of mounted police, State constables, etc. Study food and seed laws.

Physiology.—Study farm products as food and their relation to diet. Call attention to similarity of structures and diseases of farm animals and people. Discuss cleanliness and care of food as a hygienic matter and as a business matter. Study sanitary and hygienic relations to home and farm conditions, equipment, activities, etc.

Drawing and Writing.—Draw the whole or parts of plants, animals, and objects being studied. The aim should be to represent just what is seen by study of the actual object. Crude drawings are better than artistic pictures. Maps of the farms to show lay-off, rotations, plats of orchards, etc. Make drawings and figures or diagrams for booklets. Be sure not to accept any pages for booklets unless well written. If poorly written, have them written and rewritten until sufficiently neat and legible.

Music.—Have pupils learn songs that pertain to rural life as Queen Autumn, The Farmer, Song of the Harvest, etc.

Industrial Work.—Have pupils make corn tray or board, garden devices, handy articles, fly-traps, trap-nests, corn husk mats, baskets, etc.

A YEAR'S CORRELATION WORK WITH CORN

September and October

Field and Laboratory Work.—Take class to field and study stand, barren stalks, and diseases as outlined in chart following this correlation work. Study location of ears on stalk, leaves, rain guard, ligule, tassel; pull up some stalks and study roots, watch for signs of insect injuries, insects and fungous diseases. Take stalks to school-house and cut into node lengths; study structure of stalk, fibrovascular bundles, pith, sheath, and if pupils are old enough have them learn about pollination, fertilization, xenia, Mendelian segregations, law of averages, and mutations. Make sack and gather seed in field.

Have pupils study stand in fields at home; try to learn who has the best stand in the district. Have pupils learn to estimate yields in the field.

Industrial Work.—Learn to tie up seed corn, or, if parents prefer, make and fasten seed corn to racks or boards. Have pupils do weaving and mat-

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* This corn correlation study is adapted from one made by E. C. Bishop and published in Iowa Bulletin No. 8, Vol. XII.

making with husks. Have them gather clean, bright husks to be used later in the year. Dry the husks as farmers dry tobacco.

Reading.—Lessons on Corn in Farm Life Reader, Book Five; Farmers' Bulletins Nos. 229, 313, 253, 303, and 292. Whittier's Corn Song, Celia Thaxter's The National Emblem.

Language, Grammar and Spelling.—Oral discussions; Essays on Seed Selecting and Storing; Reports of Field Studies; Compositions on Harvesting Corn; the best pages from all compositions to be saved for the Corn Booklet.

Arithmetic.—Problems on determining yields, number of stalks to an acre, kernels on an ear and how much of an acre a good ear will plant, cost of harvesting, filling silo, shrinkage and value of crop. See problems in "The Corn Lady," pages 80 to 99; also Farm Arithmetics.

Geography.—Study home geography as related to corn production. What is the length of season? What is the time of the last frost in the spring? The average time of the earliest frost in the fall? What is the average summer temperature, that is, on what geographical isotherm is the district? What is the night temperature? What is the average rainfall and during what months does most fall? Compare home yields with those of other places and seek to learn causes.

History and Civics.—History of the Corn Plant, how the Indians raised and used corn, history of corn harvesting machinery (see Farmers' Bulletin No. 303). Study national and local land surveys to give fields a definite location.

Physiology.—What is the value of green corn for animal feeds? For human food? What is the relative value of different parts of the plant? See Farmers' Bulletin No. 298.

Drawing and Writing.—Make drawing of the corn plant, write pages for Corn Booklet, remember that there are three attributes of good writing—ease, legibility and speed. Make blue prints for corn board.

Music.—"When Corn is Waving," *Choral Song Book;* and "Song of the Harvesters," *Riverside Graded Song Book,* part 2.

Domestic Science.—How to cook and serve green corn, how to can corn. How may a woman put up the most corn in the best form for human food?

November and December

Field and Laboratory Studies.—Study how best to harvest corn, cutting, husking, shredding, putting in silo, stacking; study losses in handling. What is the most economical harvesting machine? How is seed corn best preserved? Study the corn kernel and learn to score and judge corn.

Industrial Work.—From drawings made during the month of October, make Corn Board or Seed Tray. This is almost an ideal Manual Training exercise for a rural school, being as complex as a beginner requires, being useful in the school and useful later in the home. A corn board (see Fig. 55) requires sawing, planing, boring, nailing and surfacing. Prepare ten ears for corn show, study how to wrap, label and pack. Have smaller children braid and make corn-husk mats, baskets and covers. String popcorn for Christmas decorations.

Reading.—Whittier's The Huskers; Farmers' Bulletins Nos. 303, 313, 409, 272; get from your State College bulletins on corn, also have pupils bring reliable farm journals and use articles on corn for supplementary reading.

Language, Grammar and Spelling.—Oral discussions; have pupils take notes while reading and then make short talks from their notes; have essays on harvesting corn, storing, how to make a rat-proof crib, how to ventilate a crib, corn judging, corn shows, results of corn club work, de-

scriptions of the corn kernel and other parts of the corn plant. The best pages to be kept for the Corn Booklet.

Arithmetic.—Problems on shrinkage of corn, cost of harvesting and marketing, cost of producing an acre of corn, cost per bushel, cost of fertilizers, labor schedules for horses and men.

Geography.—Study maturity of corn, effects of freezing on food value and germination; where can corn not be kept on account of seed weevil? Study effects of soil, slopes, windbreaks on yields and maturity. Study markets; where does the corn go to? If fed to animals, where do they go to?

History and Civics.—The economic and political meaning of a corn crop, what the government is doing to secure markets for corn and corn products. Recommendations of consuls. What is State College doing to help corn growers?

Physiology.—Corn as human food, see Farmers' Bulletin No. 298; effects of distillation on human system. Protein, carbohydrates and minerals in corn compared with wheat.

Drawing and Writing.—Drawings of the corn kernel, drawings of the home fields, rewrite pages for Corn Booklet.

Music.—"*The Corn Song,*" *Folk Songs and other Songs;* "The Pop-Corn People," *Songs of the Child's World.* Repeat songs of September and October.

Domestic Science.—Early methods of preparing and serving corn, cooking corn products for the corn show.

January and February

Laboratory Studies.—Learn to select seed corn, practise scoring, grade corn and file planter plates to fit size of kernels, test seed corn, use both box and rag doll.

Industrial Work.—Make seed corn testing box, see Fig. 19. Make furniture with corn husks, string corn kernels for portieres.

Reading.—These are the months for reading; books, farm journals and government and State bulletins will need to be read on nearly every topic given. But the emphasis should be on reading how to secure good seed and how to breed corn; however, something should be read on how to grow corn.

Drawing and Writing.—Make blue print for seed testing box, make maps of home fields, try to re-map for better rotations; make map of United States, showing corn belt and other corn States. Continue writing or recopying pages for Corn Booklet.

Language, Grammar and Spelling.—Oral discussions, write directions for making a seed corn box, directions for testing seed corn, write a survey of the district telling acreage of corn, the place of corn in the rotation, the relative value of corn compared with other crops, write an account of what becomes of the corn crop, stock fed, and what becomes of the stock.

Arithmetic.—Problems from questions of crop rotations, remapping, seed testing problems, time required, value of tested seed, profit from testing, problems on what may be gained by better methods of growing corn.

Geography.—Study the corn belt and why it is the corn belt, describe the people of the corn belt; has corn any influence in changing them? What other countries grow corn? In what markets does their corn compete with ours?

History and Civics.—What has corn done for your State? What has been its influence in the corn belt? What has been the effect on the soil? What are the prospects for the future? What transportation problems has

corn created and what is the government doing to solve them? What are seed corn trains, and how run?

Physiology.—Why corn alone is not a balanced ration and how alfalfa helps to supplement corn; what human beings need in addition to corn for a balanced ration.

Music.—"Rustle and Blow," *Nature Songs and Stories;* "The Nation's Emblem," *Riverside Graded Song Book;* repeat songs of previous months.

Domestic Science.—Cooking corn breads, steam bread and mushes. Study to determine how farm corn may be used to economic and dietetic advantage.

March, April and May

Field and Laboratory Studies.—Seed germination, root hairs and their functions, comparative length of roots and stalks and the lesson for cultivating, food and moisture requirements of the corn plant, preparation of seed bed, shelling seed corn, grading, weeds injurious to corn and how best kept in check, insects, plant diseases, gophers, squirrels, moles and bird enemies, depth of planting.

Industrial Work.—Thinning corn, fertilizer tests, fitting seed planter plates, making square and learning how to plant so that planter crosses wire at right angles.

Reading.—Send to Experiment Station and to United States Department of Agriculture for latest bulletins on growing corn, have pupils bring agricultural papers and read on preparation of seed bed, planting, cultivating; have pupils read books from school library, Crossley and Bowman's Corn, Holden's Corn Secrets, Farmers' Bulletins 537 and 409, text-books on agriculture; some of the older pupils should read on breeding corn, how it is done, what results we may expect, how corn behaves in verifying the Galton, Mendelian, DeVries, and other laws of breeding.

Drawing and Writing.—Make drawings for fertilizer experiments, drawings to illustrate how to plant and check straight, drawings of insect enemies, drawings of weed seedlings, seeds, and drawings of seed bed conditions. Write booklet pages on planting, preparation of seed bed, cultivating, and all that is left of how to grow an acre of corn (see Farmers' Bulletins).

Language, Grammar and Spelling.—Oral discussions, have pupils make outlines of topics and talk from these, have debates on how best to plant or grow corn, the relative value of corn compared with other crops, have written reports or readings on corn enemies, short course on Farmers' Institute lectures.

Arithmetic.—Problems on the cost of seed bed preparation, labor schedules, percentage problems on losses from poor seed, insect ravages, water conservation and losses, low yields, and methods of combating weeds and enemies.

Geography.—Keep weather chart, determine temperature of soil at planting time, time required for corn to germinate in soil of different temperatures. What are people doing in the different places where corn is grown?

History and Civics.—What is the government doing to help hold in check weeds? Plant diseases? Bird enemies? Rodents? What laws protect a farmer against hunters and stock?

Physiology.—How insects affect health in rural districts, how weeds affect health, the dangers from rats.

Music.—The State song, "How Corn Grows," *Child's Song Book.*

Domestic Science.—Starch and its uses; corn starch and its uses.

Chart for the Study of Corn in the Field

First Count:

No. of hills.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
No. of stalks...																									
No. of suckers..																									
No. of barren stalks.......																									
No. of smutted stalks.......																									

Second Count:

No. of hills....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
No. of stalks...																									
No. of suckers..																									
No. of barren stalks.......																									
No. of smutted stalks.......																									

Third Count:

No. of hills.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
No. of stalks...																									
No. of suckers..																									
No. of barren stalks.......																									
No. of smutted stalks.......																									

Fourth Count:

No. of hills.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
No. of stalks...																									
No. of suckers..																									
No. of barren stalks.......																									
No. of smutted stalks.......																									

Total number of stalks in the 100 hills	....
Total number of suckers in the 100 hills..........................	....
Total number of barren stalks in the 100 hills......................	....
Total number of smutted stalks in the 100 hills	....

Use of the Chart.—This chart is used for the season. By it, if studies are made in the field, we learn the stand before cultivation, the stand after cultivation, the percentage of suckers, barren stalks, hills, and the prevalence of diseases. If there are five pupils, each may make the study of five hills; if ten pupils, each two study five hills; if twenty, each two study one-half the hills.

BOOKLETS

The Booklet Work.—Booklets have been used for years in the German and other European schools but have not been used in America until recently. They have, however, recently been introduced and are a wonderful, quickening and vitalizing factor in the schools. These booklets are much like the science and mathematics laboratory note-books used in teaching the higher grades. They differ from the laboratory note-book in being more interesting and beautiful. The booklets correlate in so many ways that one hesitates about where to begin a description. The covers may be the plain purchased covers, or better, covers made of wrapping paper or stiff cardboard that may be obtained at any printing shop. The filler paper can be taken from tablets, bought at the printing office, or better, the paper put up in small packages, uniform in size and already punched with holes for the strings or ribbons with which the booklets are to be tied. Paper nine by eleven inches is preferable.

Booklets Permanent Filing Places.—These booklets are permanent filing places for whatever is drawn, pasted, or written on the work in agriculture. There is no other material that makes such attractive exhibit work. In Wright County, Iowa, the booklets are a leading feature at the county fair. If agriculture is a mode of living in the country and if to get ready for country life one must learn to enjoy the beautiful, especially that which does not cost much money, then it follows that the principles of art should have a vital place in the country school. The covers and some of the pages of these booklets offer an excellent opportunity to teach the principles of decorative art and to give the pupils a chance to apply the principles taught. Then, too, the beautiful pictures of fruit, animals, seeds, bread, pets, farm conveniences, etc., deepen the child's love for things in the country. Little clippings from the farm papers, little poems about the subject of the booklet, original sketches, etc., should

find their place in the booklets and should be made to add interest and beauty. The booklet should be the property of the child and should contain tables, drawings, receipts, or other information that will make the booklet of permanent interest. It would take a book to tell the stories of how these booklets have made pupils take renewed interest in their schools. A boy who would not go to school was asked to make a booklet on cattle for the county fair; another boy was asked to make one on Rover, his favorite pet. Both boys needed the help of the teacher. Both began to read and write. Both desired to be better readers and writers. Both saw the need of better English. Each one wrote something like one hundred and twenty pages in order to get enough good pages for his booklet. Each learned something of geography while tracing the origin of the Scotch collie or the Durham cattle. Each learned something of art and became interested in the farm papers. The school and the home and the teacher and the boy were drawn closer together by those little booklets. The boys were in the do-something age and the booklets gave them something to do. The growth of extravagance and city living is one national danger, therefore anything that makes simple living and country life more attractive is a patriotic duty. We may make mistakes, but who makes no mistakes?

Advantages of the Booklet Work.—Mr. O. H. Benson, who is head of the Boys' and Girls' club work at Washington, says of the booklet:

1. It encourages a great deal of extra and supplementary reading, thus stimulating to greater efficiency in "Reading."
2. It teaches useful information by three most effective methods, viz.:
   (*a*) By getting the child to seek and find truth largely by his own effort.
   (*b*) By illustrating the truth in drawing and picture.
   (*c*) By writing about the subjects in the child's own language.
3. It teaches the correct use of English and renders the "Grammar bugbear" a thing of interest and daily practice, instead of a jumble of technical, analytical points, which, as a rule, are fit for theorists and not for boys and girls.
4. It trains for better penmanship by giving definite direction in daily practice, live practice, in which interesting truth is involved.
5. It teaches the child how and where to go in quest of truth, from all sources—from men, books, papers, nature and from experiment and demonstration.
6. It trains in neatness and organizing ability—facts must be organized in sequel order in booklet work.

7. The booklet develops individuality, originality and independence in their educational training and property rights are incidentally respected.

8. It trains for economy by encouraging the child to use waste paper, farm journals, catalogues and material in making up the neat and attractive booklet for local, county and State exhibits.

9. It brings the home, school and farm into closer coöperation and gives them a common sympathy in business, of rural uplift and better educational facilities.

10. This form of agricultural education will dignify home and farm interests by correlating the common things with daily work in the common branches, such as geography, grammar, arithmetic, physiology, writing, etc., and in helping both teacher and the taught to substitute live and vital work for many dead and useless pages designed for formal discipline only.

To this E. C. Bishop of the Iowa Boys' and Girls' Clubs adds:

(1) Pupils like to do the booklet work; (2) the making of the booklet helps to crystallize the pupil's knowledge; (3) each pupil works by himself and on a subject in which he is interested; (4) booklets are really permanent note-books, the home folks like to see the systematized and clearly and definitely expressed knowledge of the child in attractive, permanent form; (5) each child likes to make collections and investigations even with the least of direction.

Tomato Booklets.—Boys and girls in the National Corn, Potato, Poultry, Canning and other clubs are to make a booklet as a regular part of their requirement for winning. It has been suggested that, for school work, we mark the booklets as follows:

1. Contents	20 per cent.
2. Neatness	20 per cent.
3. Originality	20 per cent.
4. Amount	20 per cent.
5. Arrangement	20 per cent.

Mr. Benson in one of his circulars gives the following outline for a girls' booklet, topics to be treated in consecutive order in the booklet:

1. The object of the girl's canning or poultry club work.
2. Why I enrolled as a club member.
3. Life history of tomato, snap beans or cucumber. It is well to use but one of these subjects in each booklet.
4. Soil study, seed-bed, cultivation. Tell how to select and prepare a garden seed-bed.
5. Management of plants from cold frame to maturing crop. Tell here how to raise plants, transplant, cultivate, stake or rack up plants.
6. Management of diseases and insects.
7. Management of fruit and vegetables, ripening, picking, marketing fresh products, tell best method to pack and crate ripe tomatoes.
8. Canning process, labelling of cans, meaning of label and trade-mark.
9. Exhibits; relation to school work.

10. Discussion of uses for tomatoes, snap beans or cucumbers. Give recipes of important and practical dishes and food values.

11. Give account of your yield, total number of pounds, how much used for home and how much sold, number of cans, etc.

12. State briefly what your club work has done for you in interest, instruction, health and money value.

Make a cover design which will, in a neat and attractive manner, indicate just what can be found within the booklet. Do not make the cover design too gaudy in color. Use water color paints, and if possible in drawing tomato, marginal lines, etc. Bind the *booklet at the top* with a modest colored baby ribbon or cord. Ask your teacher for coöperation in getting out your booklet and illustrating it. It will be well to illustrate your story as you proceed.

Corn Booklets.—The following is one of a number of outlines that have been made for a booklet on corn:

1. Legends or literature about corn.
2. Uses and commercial articles from corn.
3. Where corn is grown and importance of corn to American farmers.
4. The corn plant:
   Roots.
   Stalk and leaves.
   Flowers (*a*) staminate or tassel, (*b*) pistilate or ear.
   Fruit, and what constitutes a good ear of corn.
5. Corn judging and the use of the score card.
6. Gathering seed corn in the field.
7. Storing seed corn.
8. Testing and grading seed.
9. Planting, soil, seed-bed, hand and machine methods, etc.
10. Harvesting corn for the silo, fodder, husking, etc.
11. Corn breeding, seed corn, hill-row method, etc.
12. The corn-club work.

Some general cautions and directions need to be given. A booklet is not an encyclopedia or a catalogue of knowledge. Only thoroughly digested matter, told in the child's own words, should go into the booklet. Of course illustrations, tables and quotations are excepted, but these may generally best be cut and inserted as clippings. Bookish booklets should be avoided. The child's experiences are the most valuable part of the booklet matter. For this reason the United States Government men require the child to write "How I grew my acre; how I grew and canned my tomatoes; how I grew my potatoes, etc." The booklets should be written in ink, on paper 8½ by 11 or 9 by 12 inches. The pupil should apply the common rules of composition, have correct spelling, and put forth his very best efforts at good penmanship. The cover page, as stated above, may have the title of the booklet, an appropriate illustration and the name of the author. The second page may have the name of the subject,

the name of the writer, his or her grade, school, county, club name, etc. The second page may contain the table of contents which should tell you on what page you may find each topic. The booklet must be bound at the end so as to hang on a line.

These booklets make wonderfully attractive material for exhibits at county fairs, fall festivals, farmers' institutes, Grange meetings, graduating exercises, district and state fairs. They should be kept neat and clean, but nevertheless should be taken home and read by the home folk. They should belong to the pupil and his property rights should be rigidly respected. The booklet does not need to be made all at one time, but the pupil may file each page as he makes one good enough and then at the end of the term, study or year, gather his pages together, arrange them, make his cover, table of contents, etc.

Booklets for Introducing Agriculture.—The booklets make a good method or device for introducing Agriculture and Domestic Science. You need not say that you are going to teach Agriculture, Domestic Science or Nature Study. All you need to do is to say that we are to write a booklet on corn, the potato, use of garden vegetables, sewing or whatever it may be. Explain that the booklets are to be used for school exhibits, that when the pupil is older he may wish to belong to a corn or canning club, and to know how to make a booklet is to have an advantage.

It is well to have on hand a number of different bulletins for each pupil. The pupils should be encouraged to bring the farm journals from home. These should be preserved and then examined for illustrations, tables, information, etc.

Booklets for Other Branches.—Older pupils like to make booklets quite as well as younger ones. At the West Chester State Normal School, the members of the botany class are required to make two booklets each. One is on a typical monocot and one on a typical dicot. The monocot may be corn wheat, cane, oats, etc. The dicot may be the apple, the potato, the tomato, etc. These booklets made in the botany class are frequently of use to the members of the senior class while taking agriculture. In the senior year the members make lesson plans on teaching the different subjects, such as poultry, dairying, horses, etc. These lesson plans are frequently bound and used for school exhibits. The pupils are encouraged to take their booklets home, have them read or read them and then invite

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criticism. That frequently leads to parents sending for the bulletins from which certain information was gathered. Sometimes questions about the meaning of certain things taught, sometimes requests for advice as to poultry business, planting alfalfa, selecting corn for shows, etc., are sent in by the parents, and thus the school and the home are brought closer together. The booklets make a way for the teacher to be of service to the community, to help the parents at home, to guide the boy during his summer vacation, to utilize his and his father's experience. This is going a long way toward socializing the school as I understand the term socialize.

LESSON PLANS

The Lesson Plan in Agriculture.—There are a number of reasons why well-made lesson plans are especially valuable to the teacher of agriculture. We are to make agriculture most interesting when we teach much of what is too new to have found a place in books. Of course teachers must be sure that what they teach is worth while, is worth doing, and is within the understanding of the pupils being taught. There is more danger, however, that teachers of agriculture will teach what is under rather than over the understanding of the pupils. Pupils who live in the country and associate daily with farmers know more about agriculture than we give them credit for. Lesson plans are very useful to teachers who teach from things instead of from books. The numerous excellent books containing a discussion of what a lesson plan is and how it is used, make a detailed consideration of those matters unnecessary in this place. Those interested should consult the excellent books by McMurry, DeGarmo, Rein, and Bagley's "The Educative Process," Chapters XIX and XX. I refer to this especially because Bagley makes it plain that a lesson plan is useful whether the lesson be inductive or deductive.

A well-worked-out lesson plan gives a teacher her aim, and if she be reasonably careful it keeps her from wandering too far afield. This is the great danger when teaching from things instead of from a book. The working out of the lesson plan forces the teacher to think the subject through, so that she understands what she is to teach; the making of the lesson plan gives her a body of information, crowding her, as it were, for expres-

sion, and this in turn gives her warmth and enthusiasm for the lesson.

Then, too, a lesson plan while primarily for the teacher's own use readily enables her to show her supervisor what she is doing, has done, and intends to do. Needless to say, the lesson plan enables the teacher to use the Socratic method, and this method also enables her to draw from the pupils much of the subject-matter of the lesson. This is accomplished by questions well arranged in a logical sequence, and these questions with their answers make the lesson much more interesting to and easily remembered by the pupils.

What is in a Lesson Plan?—It is hard to tell just what goes into a lesson plan. The true teacher will use the lesson plan as a guide, varying, adding to or leaving off as occasion demands. There are in a full lesson plan five or six steps. There should be a clear, short, concise statement of the teacher's aim. This is for the teacher and hence not always counted as a formal step. This leaves five formal steps to be taken for and used with the pupils: First, *Preparation* of the pupil's mind to make him desire the lesson to be taught. At the close of this first formal step, there should be a restatement of the aim from the pupil's standpoint. This subordinate statement of the aim generally begins with some such expression as, "Let us learn. Would you like to learn? How may we learn?" etc. Following the preparation is the second formal step, which is called *Presentation.* While he is teaching the teacher will, so far as he can, draw the subject-matter from the pupils by well-worded questions. He frequently has to tell much and for that reason it is well in his lesson plan to have a rather full and dogmatic statement of what he wishes the pupils to know. Presentation is the main part and hence should receive emphasis. A teacher should not think that he has a well-prepared lesson plan if he has less than one-half or more of the whole plan given to presentation. The third step is *Comparison,* which may be either or both to show what the thing is like or is not like, *i.e.,* analogy and contrast. The fourth step is *Generalization,* which may be the statement of a rule or definition but in agriculture is more frequently a short, striking summary of what was presented. The last step is more important in agriculture, which is a vocational subject, than it is in the so-called "cultural" subjects.

When we aim to enable pupils to understand, application is not of such relative importance. But in agriculture, where we aim to get the pupils to do and do better than is being done, the fifth step called *Application* is a very important step. It is here that we may send them from the class to search book and bulletin for additional information on the subject. It is by application that we may send them to observe the practices of the leading agriculturists; it is by application that we may get the pupil to apply the lesson as his practicum or home project. Man's superiority over the other animals does not consist so much in his superior brain as in his wonderful development of the hand. And here again we meet the necessity for doing in order to learn. "The worst gift," says Pestalozzi, "that an evil genius has made to our age is knowledge without training." "We are inclined," says DeGarmo, "to think our work done when the student apperceives, but this is only the stage of clearness; if we would have him reach the stage of vividness, we must see that he acquires the necessary technique." The measure of the success of the vocational teacher is found in what he gets the pupils to do.

THE STRUCTURE AND CARE OF EGGS

Aim.—To learn the structure so as to know how to care for eggs.

Materials.—Two or three eggs, two or three saucers, and one or two long needles.

Preparation.—Do farmers ever take bad eggs to town? How do the merchants tell which are bad? Yes, by candling them. It is claimed that over one-eighth of the eggs taken to town are bad and hence the merchants have to pay the farmers enough less or else charge the bad ones back to the farmers. This in one year amounts to something over fifty million dollars. How may the farmers avoid having bad eggs? Yes, but before the farmer will take better care of his eggs, he must know more about what an egg is. Let us see some of the wonderful things there are in an egg.

Presentation.—The teacher holding up an egg. What do you notice about this egg? Yes, color, form, roughness, etc. Did you ever touch an egg immediately after it was laid? How did it feel? Yes, sticky. And that stickiness was made by a covering of mucus which is necessary to keep out bacteria which might injure the contents of the egg. Now if the nest was dirty and hence the egg laid in filth and then gathered and washed, what injury was done? Yes, the mucous coating was washed off and perhaps some of the filth was washed or pushed into the pores of the egg shell. The egg shell has many little pores, so that while the little chick is hatching it can get air.

Both size and color may be important to the man selling eggs. Some markets pay more for brown eggs and some pay more for white eggs. In some States a certain number of ounces make a dozen and the man who brings small eggs must give thirteen for a dozen.

Have you ever broken an egg? What did you find inside? Did the contents entirely fill the shell? At which end was the air space? Did the lining come out with the white and yolk? How many kinds of white? The air space is to give the little chick air and to furnish room for it to develop and the white is for food. The main part of the yolk is also for food. (The teacher breaks the egg and lets the pupils first examine the shell and then the contents, which she passes around in a saucer.) Now I wonder who saw something more to tell about the yolk? Yes, it has a spot in it and that spot is called the nucleus. It is there that the little chick begins. If the egg was unfertilized, no little chick can start, but the egg will keep for cooking much longer. There are wonderful secrets wrapped up in that little nucleus about which you are to learn in zoölogy, and when you are old enough to understand the discoveries of Gregory Mendel. But there are some other things that some one should have seen. Yes, there are streaming out from either side of the yolk, two strings. What do you think they are for? They are the ends or torn parts of a sack called the chalaza. This sack holds the yolk in place near the centre of the egg contents. Now if the farmer puts his eggs in a box and puts the box in the back of a road wagon and

A

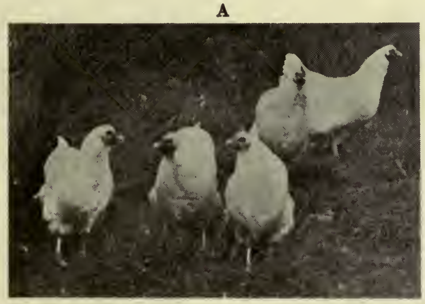


Fig. 139 A.—Wyandottes, the champion pen of five hens, at the third North American Laying Contest. These five hens laid 1180 eggs in one year.

B

Fig. 139 B.—A Wyandotte hen that laid 280 eggs in one year. She was bred to lay.

then goes to market humpty dumpty over the hard, rough roads, what do you think happens to the chalaza? Yes, it is broken, and then the yolk is mixed with the white and the egg soon spoils. If he should want the egg to set, no little chick could hatch from an egg with a broken chalaza. What does this teach us about how to handle eggs? Yes, eggs must be handled carefully for both market and for setting. The parts of an egg, then, are the mucous covering, the shell, the lining, the dense and light white, the yolk, the nucleus, and the chalaza, all of which a farmer must understand in order to know how to pack, market, and set eggs.

Comparison.—Compare the way eggs are handled from your home and the way we have learned they should be handled.

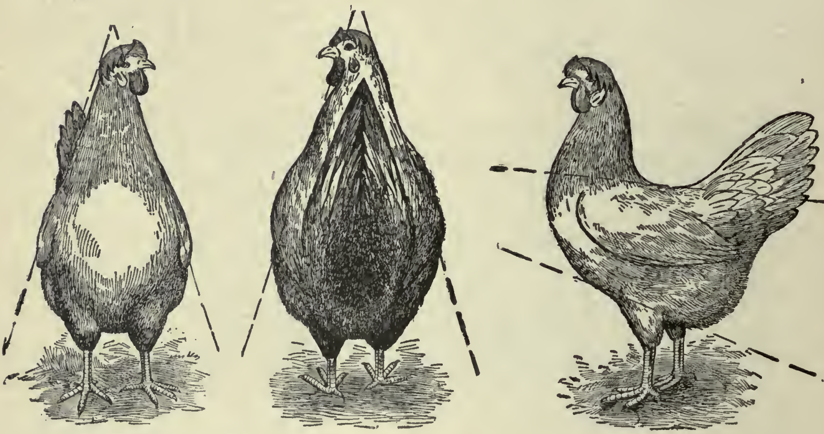
Application.—Get the folks at home to let you gather the eggs or to see if you cannot discover a better market for first-class eggs.

HENS FOR MORE EGGS

Aim.—To learn how to breed hens for more eggs.

Preparation.—The average American hen lays less than 80 eggs in one year. Five hundred hens from different countries, but all entered and kept

for the year in the North American egg-laying contest at Engelside, near Philadelphia, averaged over 170 eggs each in one year. These hens were bred to lay more eggs. The champion hen of America, in the Oregon contest, laid 303 eggs. She, too, was bred to lay. Mr. Tom Barron, of England, was one of the first to do scientific breeding for more eggs, and his hens led in each of the four great American contests. From these facts, do you conclude that there is anything in breeding for more eggs? How do you think it is done? How do you think Tom Barron handles his hens? One more egg from each hen would add something like $4,000,000 to the egg values of the American poultry raisers each year. The income from eggs now equals the income from the gold and silver mines combined. Can we double it without increasing the number of laying hens? Is breeding hens for more eggs worth while? Would you like to learn how to breed hens for more eggs? (Figs. 139 and 140.)



From "Productive Poultry Husbandry" (Lewis).

FIG. 140.—Showing the wedge or angular shape which is so common in good layers. The heavy development toward the back may be seen from side, front, and rear.

Presentation.—Before we begin the study of how to breed hens for more eggs, there are certain things which we should have in mind. One is that the breeder can be much surer of what he is doing if he is a master of the laws of breeding, especially the law of averages, the law of hybrids, the law of reversion, and the theory of mutants.

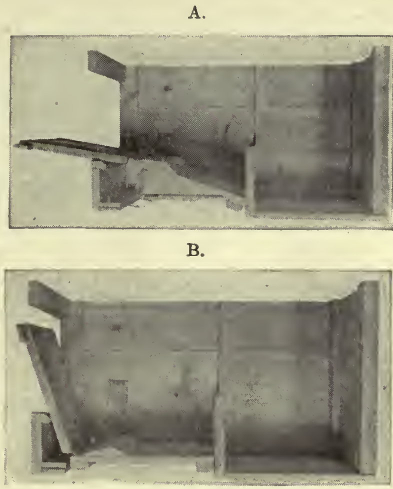
Another thing which we should bear in mind is the fact that a hen bred to lay more eggs may not be able to do so because of poor housing, poor care, or poor feeding; therefore the breeder should be master of housing, care, and feeding, but of these we must learn in other lessons.

The third thing which we should know is that a hen is born with all of the embryo eggs that she can ever have. She probably has more than she will ever lay, but hens differ very much in the number that we can get them to lay the first or second year. What would be the advantage of having hens that laid most of their eggs the first and second years? The fourth thing to remember is the fact that the maximum profits on a hen laying eggs to sell in the market may be obtained by the end of her first year of laying. If she is a very good layer, it pays to keep her the second year for eggs to set.

A fifth fact to bear in mind is the fact that a hen will lay more eggs, the eggs will be better for food and keep longer if the male bird does not run with the hen. And a sixth fact to remember is that man has developed hens for different purposes. The Asiatic—Langshans, Brahmas and Cochins—were bred to develop meat. The Mediterranean—Spanish, Red Caps, Leghorns, Hamburgs, and others—were bred to lay large numbers of eggs but not necessarily large eggs. Some States require thirteen small eggs to make a dozen. The Americans, Plymouth Rocks, Rhode Island Reds, Buckeyes, Wyandottes and others, were bred for both meat and eggs. These double-purpose hens have been leading in some of the egg-laying contests for both number and number of pounds of eggs laid in a year. The last and seventh fact which we need for our lesson on how to breed hens for more eggs, is the fact that different markets not only demand different sized eggs but may demand different colored eggs.

Certainly a man starting to breed hens for more eggs should start with stock known to be bred in the past for laying a reasonable number of reasonably fair-sized and right-colored eggs for the market. Having these hens, how may he determine which are the heavy layers and which the light layers? That is the problem the first year. During the year which he takes to learn this he may sell infertile eggs in the market. Why does he not care to set the eggs?

The trap-nest is the device invented for determining which are heavy and which light layers. (Teacher have present and explain the trap-nest, Figs. 141 and 142.) Now having trap-nested the hens the first year, what may a man do for the second year? Yes, sell the light layers and get eggs to set from the heavy layers. But for this we must have fertile eggs. What characteristics do we want in the male bird? Suppose a man does not have time to trap-nest his hens but buys male birds from men who have used the trap-nest and hence know that they are from heavy layers? The little chicks would be one-half egg-laying strains the first cross, the second cross three-fourths, the third generation seven-eighths, etc.



From "Productive Poultry Husbandry" (Lewis).

FIG. 141.—Pearl or Maine State trap-nest, side removed. A, open; B, sprung or shut. The weight of the hen on the hinged bottom keeps the door closed. (Photo by Raymond Pearl.)

Comparison.—Compare the trap-nest method with the method commonly used in the district. Compare the buying of male birds from egg strains.

Generalization.—There are two methods of breeding, first the trap-nesting, and second, using the male birds from trap-nested stock.

Application.—Read to learn if there be a still better method. Visit a poultry plant where the hens are being trap-nested. Or, better, take charge of part of the poultry flock at home for a home project and trap-nest hens so as to breed for more eggs.

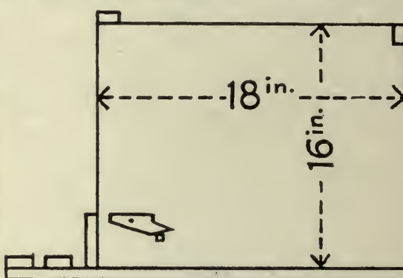
FERTILIZERS—NITROGEN

Aim.—To teach the sources and uses of nitrogen in plant growth.

Preparation.—Why do boys and girls eat? Yes, in order to grow. Do you think that plants have to have food in order to grow? Yes, they do, but their food is somewhat different from ours. Plants need some ten or thirteen elements of which you are to learn when you study chemistry. Now it will be sufficient for me to tell you that among these elements is one called nitrogen, and of this we are to learn where plants get it and what they do with it.

Presentation.—Notice the air about you. It is called a gas. But it is a mixture of two or more gases. Four-fifths of the air is nitrogen, and yet much of the hard work of your father and mother is done in order to get food containing enough nitrogen. Nitrogen makes muscle. We may get it from lean meat or from plants, especially the legumes. If plants contain it, and if we let the plant decay in the soil, the next plant living in that soil may take up that nitrogen for its food. In what forms do farmers haul old decaying plant stems back to the field? Yes, in barn-yard manure and from the compost heaps. But that does not give us enough nitrogen to make large crops on all of the fields. So I must tell you of some wonderful little plants called bacteria. These bacteria that I am to tell

From "Productive Poultry Husbandry" (Lewis).



Side view.

FIG. 142.—Improved Connecticut trap nest. Center nest open; the hen on entering raises the door and allows the trigger to fall; this locks the door shut until the attendant comes. (Tops removed for photographing.) This type of trap was designed by F. H. Stoneburn, formerly of Connecticut Agricultural College.

you about live near or on the roots of plants whose seeds are in pods. What plants have seeds in pods? Yes, beans, peas, clovers, alfalfa, vetch, some trees and shrubs, etc. These little bacteria are so small that you cannot see one of them without a very good microscope, but you can see many of them clustered together. Here (teacher showing nodules) are some of the clusters. Each cluster is called a nodule and contains many thousands of bacteria. Now these little plants have the peculiar and very helpful power to take nitrogen from the air in the soil. You see the soil breathes much as we do. When a strong gust of wind comes the air is drawn out of the soil and then, when the wind slacks up, the air rushes back into the soil. This gives the soil frequent changes of air and from this air the bacteria take nitrogen, some of which they store up in their bodies and some of which they give to the surrounding plants. Even other kinds of plants which grow near may take some of the nitrogen from the bacteria, so that corn is better for having cowpeas growing in it and wheat for having clover growing in the wheat field. This nitrogen taken up by the plants gives them

dark green leaves. Plants without nitrogen are apt to be yellow. Plants with plenty of nitrogen grow larger of leaf and stem and look stronger. If stock eat the leaves and stems they make muscle out of the nitrogen, and then, if we eat the meat, we get muscle. In that way the little bacteria really toil to lay up food for you and me.

There are a number of other sources of nitrogen. The farmer may use some of the commercial fertilizers such as sodium nitrate, nitrate of potash, ammonium nitrate, ammonium sulfate and others. But these are expensive. If the farmer is careful to conserve his barn-yard manure, much of the nitrogen is returned to the land.

Comparison.—Dig up clover, sweet clover, alfalfa, cowpeas, soy beans, garden peas, garden beans, peanuts or vetch, and compare the nodules. Which are the largest?

Generalization.—Nitrogen is muscle-making food. Plants get it from decaying plants or animals, from commercial fertilizers and from the air. If plants are getting nitrogen from the air, they have on their roots bacteria which form clusters called nodules.

Application.—Plant a square rod of alfalfa, vetch, soy beans, cowpeas, or other legume. Leave a path and plant another square rod with inoculated seed. Study the difference in the size of the nodules. Learn how farmers of the district inoculate their legumes.

WHY GROW ALFALFA?

Aim.—To learn why a farmer should grow alfalfa.

Preparation.—First, find out whether the children know just what alfalfa is. Then get the children to tell what crops are grown on the home farms, which are most profitable and which least profitable. Tell them of the men who have tried alfalfa, tell of its history, introduction and where grown. It is a desert plant. Its name is Arabic and it was probably introduced from Arabia into Spain, from Spain into Mexico, from Mexico into California, and from California it has gradually spread eastward. Why should the farmers grow it in your district?

Presentation.—Alfalfa is a legume and therefore has on its roots bacteria which gather nitrogen from the air. What have we learned about how a legume gathers nitrogen? Nitrogen is the most costly element that a farmer has to buy. For what have we learned it is used? There are seven very good reasons for growing alfalfa. The teacher is to draw out by questions and telling the following facts: (1) Alfalfa may be used as a green soiling crop, a pasture crop or as hay. (2) Alfalfa, if once well seeded, requires less work than other crops. (3) Alfalfa yields from four to six tons per acre of feed, equal, pound for pound, to bran or threshed oats. (4) Alfalfa stores in the soil of each acre, each year, about $25 worth of nitrogen and at the same time the alfalfa is storing deep tap-roots to act later as lamp-wicks to carry soil moisture up and down. (5) Growing animals and dairy cows need much lime, and alfalfa has 34 per cent of lime in its ash; clover has 20 per cent, and timothy has 4 per cent. (6) Alfalfa is the most drought-resistant farm crop. (7) Alfalfa, once down, stays seeded for from five to ten years.

Comparison.—When we compare alfalfa with clover we get the following:

	Alfalfa	Clover
Average tons per acre........	4	2½
Protein pounds per acre........	875	491
Nitrogen stored per acre........	$25	$15
Lime in ash....................	34 per cent	20 per cent
Lasts when down...............	5 to 10 years	1 to 2 years

Summary and Application.—Since we have found seven good reasons for growing alfalfa, let us learn in our next lesson how to grow alfalfa.

HOW TO GROW ALFALFA

Aim.—To learn how to grow alfalfa.

Preparation.—Since we have learned that alfalfa is such a valuable crop, we should spare no pains in learning how to get it started right. How do the alfalfa growers of the district start their alfalfa? Let us learn how successful growers start alfalfa.

Presentation.—Successful alfalfa growers found that there are certain things that must be done in order to grow alfalfa. 1. It should be started about August 20. This enables the farmer to get a crop of oats and pea hay or a crop of winter wheat off the land. Starting it in August enables the farmer to kill most of the weeds.

2. Alfalfa should be started on a well-drained piece of ground. A southern slope is best for alfalfa. Does any one know of a good piece being grown on a wet piece of land or on a northern slope?

3. Alfalfa requires a good, hard seed-bed, that is, the surface should be disked until it is as fine as a garden, and the undersurface should be well packed. Does any one know of a man who does that? Does any one know of men who prepare the seed-bed in another way? Which grows the better alfalfa?

4. The soil generally needs lime to sweeten it before it will grow alfalfa. Go out with a piece of blue litmus paper and open the ground down to where the soil is damp. Insert the blue litmus paper and leave it there for three hours. If the soil turns the paper red, that is an indication that there is acid in the soil and hence it needs lime. But since alfalfa is such a lover of lime, that is, requires 34 per cent for its ash, some believe that calcium carbonate or pure lime is a necessary food for alfalfa just as much as is potash or phosphoric acid.

5. Now comes a hard point. Where is the farmer to get his seed? If it is grown in some other country, it may not do well in this country. If it was grown south of his place, it will probably not be able to stand the winters so far north. If it has weed seed in it, it will not do well and may introduce the dreaded plant enemy, dodder. If dodder once gets on to a man's place, he may not be able to grow alfalfa for five or six years. How, then, can a farmer get good alfalfa seed? Yes, he must trust his seed house, but he may have the seed examined by his State College, his Farm Bureau, or the United States Department of Agriculture for impurities in the seed and tested for germination.

6. But before the alfalfa can grow large nodules of bacteria to gather nitrogen, it must be inoculated. This may be done in either of two ways. The first is to scatter over the field soil from a well-inoculated field which was free from plant diseases. The second, and many think the better way, is to use one of the many prepared liquid preparations which should be put on the seed as directed by the manufacturers. (See Fig. 84.)

Comparison.—Compare the method advocated in this lesson with the way alfalfa is being planted in your district.

Generalization.—There are six things necessary to get a good stand of alfalfa. They are: First, sowing after the weeds are killed; second, good drainage; third, hard, well-prepared seed-bed; fourth, lime; fifth, good seed; sixth, inoculation.

Application.—Plant in the school garden, or on the farm, four square rods of alfalfa. On one put lime and inoculated seed, on another inoculated seed but no lime, on a third put lime and uninoculated seed, and on the fourth put seed but no inoculation nor lime.

TOPICS FOR LESSON PLANS

The following furnish topics for additional lesson plans. Each topic in the following pages may be used for a lesson plan. The author recommends that teachers in normal schools have each pupil make a given number, say fifty or sixty lesson plans, bind them into a booklet and use for both normal exhibits and for teaching after the pupil leaves the normal school.

1. How grow an acre of corn so as to win in an acre contest.
2. How grow an acre of potatoes so as to win in an acre contest.
3. How grow wheat, oats, cotton, barley, clover, or any given garden vegetable.
4. How make a permanent pasture, or hay field.
5. How should the farmer's wood lot be managed?
6. How do we spray for any given insect or fungous disease?
7. How should we grow crops for the silo? How fill the silo?
8. How do we grow an apple tree? A peach tree? Pear tree?
9. How should we set out and maintain a strawberry bed? An asparagus bed?
10. How make a hot-bed, a cold frame, how manage a hot-house.
11. How grow grapes, currants, gooseberries, raspberries, strawberry-raspberries.
12. How make a King road drag, and how use it.
13. How fertilize for any given crop.
14. How plow, cultivate, conserve moisture.
15. How handle baby beef.
16. How handle a sow and pigs so as to win in a pig contest.
17. How handle hens for eggs, incubator, little chicks, or fatten poultry.
18. How drive or ride so as to win in a contest.
19. How build a hen-house, trap-nest, self-feeder or sanitary drinking device.
20. What is the Galton law of averages?
21. What is the Mendelian law of hybrids? Dihybrids? Trihybrids?
22. What is the law of segregation? Dominance? Reversion? Atavism?
23. What is pure line breeding? Inbreeding? For what used?
24. How cross pollinate apples, grapes, or any given fruit.
25. How bud, graft, prune, transplant any given tree.
26. How do tile draining.
27. How keep bees, feed bees, winter bees, insert queen, or hive a swarm.
28. How care for milk. How milk. How cool milk. How bottle. How wash milking utensils.
29. How house farm machinery.
30. What is genetics? Eugenics? What do they teach as to how we may get a better human family?

FARM MANAGEMENT

References.—Warren's Farm Management; Card's Farm Management; Hunt's How to Choose a Farm; Robert's The Farmstead; Farmers' Bulletins 272, 337, 355, 365, 370, 432, 454, 472, 511, 572; Text-books on Agriculture; Bureau of Plant Industry Bulletin No. 259; American Farm Management Association reports.

1. Give a short history of farming in America.
2. What are the essentials of a good farm?
3. What equipment must one have, and what does it cost?
4. Should one own or rent his farm?
5. How much labor is needed for different sized farms?
6. Does it pay to farm intensively or extensively?
7. Is syndicate farming paying?
8. What farm records and accounts should a farmer keep?
9. What advertising does it pay a farmer to do?
10. What are the best kinds of buildings and fences for your locality?
11. What can you say of the management of the most paying farms of your vicinity? What crops pay best? What animals? What rotation is practised? What system of accounts is kept?
12. Score one or two farms as paying propositions. Try to determine which kind of farming pays best.

TREES—FORESTRY

References.—Botanies, especially the parts dealing with the structure and physiology of dicots; Farmers' Bulletins 99, 173, 358, 423, 453; Hodges' Nature Study and Life; Roth's A First Book of Forestry; Fuller's Practical Forestry; Newhall's Trees of North Eastern America; Solotaroff's Shade Trees in Towns and Cities; State Station Bulletins.

1. What are your ten most beautiful shade trees?
2. What are the five most valuable trees for the wood-lot?
3. How are tree seeds started?
4. How are the little trees kept in the nurseries?
5. What are the rules for transplanting a tree?
6. How should a shade or forest tree be trimmed?
7. What is a tree doctor? What does he do to trees?
8. What insects and diseases are threatening our forests?
9. How have our government forestry practices changed since the days of Mr. Pinchot and the conservation movement?

10. What is our present National Forestry Policy? Your State Forest Policy?

APPLES, PEACHES OR PEARS

References.—Texts on Agriculture; Bailey's Principles of Fruit Growing; Bailey's Cyclopedias of Agriculture and of Horticulture; Waugh's The American Apple Orchard; Kain's Making Fruit Pay; Bailey's Field Notes on Apple Culture; Waugh's Dwarf Fruit Trees; Farmers' Bulletin 113; State Station Bulletins; Sears' Productive Orcharding.

1. What varieties are best for your locality?
2. Can an orchard be made to pay?
3. How is the fruit grown by the best farmers in your locality?
4. Demonstrate how a tree should be trimmed.
5. How should an orchard be fertilized?
6. How should fruit be gathered and packed?
7. What are the best ways to market in your district?
8. What suggestions has your Experiment Station for improvement, growing, and marketing?

FARM MACHINERY

References.—Davidson's Agricultural Engineering, also Farm Machinery and Farm Motors; Warren's Farm Management, Chapter XII; Bailey's Cyclopedia of Agriculture, Vol. II; Farmers' Bulletins Nos. 303, 347; State College Bulletins; Card's Farm Management, Chapter IV; Text-books on Agriculture, especially High School texts.

1. What is a tool? A machine? For what machines and for what parts is wood better? Iron? Copper? Other material?
2. What mechanical principles learned in your Physics are illustrated in a plow? A harrow? Other farm machines?
3. Tell the desirable attributes of a plow, disk, harrow, cultivator, pulverizer, and clod crusher.
4. What harvesting machinery is used in your locality?
5. What engines, motors, and pumps?
6. Discuss the best makes, desirable attributes, advantages of different kinds, etc., of the above.
7. What care is taken of machinery in your neighborhood? Does it pay?
8. Discuss how much a man must make each year on the different farm machines to make them pay.

THE PLOW

References.—See under Farm Machinery.

Why We Plow:

1. To produce a field of a uniform texture to such a depth as will render the maximum plant food available.

2. To add to the humus of the soil by covering to a depth, so as not to interfere with cultivation, weeds, stems of crops and manures.

3. To destroy and prevent the growth of weeds which would deprive the crop of food and moisture.

4. To modify the condition of the soil so as to make a soil mulch easily, made so as to regulate moisture.

5. To modify the soil so as to prevent excessive erosion.

Kinds of Plows: Stirring, Walking, Riding, Disk—Single, Double; Gang.

Parts of a Stirring Plow:

1. Cutting edge or share. 2. Moldboard. 3. Landside. 4. Frog. 5. Brace. 6. Beam. 7. Clevis. 8. Handles. 9. Casters and coulters.

History of the Plow.

What plow do the farmers in your locality find best?

POULTRY

References.—Text-books; Robinson's Principles and Practice of Poultry Culture; Davenport's Principles of Breeding; Davenport's Domestic Animals and Plants; Valentine's How to Keep Hens; Purvis' Poultry Breeding; Harper's Animal Husbandry; Plumb's Beginnings in Animal Husbandry; Bailey's Cyclopedia of Agriculture; Farmers' Bulletins Nos. 51, 128, 236, 287, 355, 357, 528, 530, 562, 574, 594, 624; State College Bulletins; Lewis' Productive Poultry Husbandry.

1. What qualifications are needed for success with poultry?
2. What are the chances for success in your locality?
3. Name the different breeds of poultry.
4. Which breed is best for your locality?
5. How should poultry be housed?
6. How should poultry be fed: (1) For eggs? (2) For growth?
7. Should one use the hen or incubator for hatching?

8. Should one use hens or brooders for young chicks?

9. Learn to use the score card on your favorite breed.

10. Learn how to balance a ration for chickens, how to run an incubator, how to build a trap-nest, how to construct a poultry house, how to make hens lay in the winter time, or how to care for young chickens.*

DAIRYING

References.—Text-books on Agriculture; Bailey's Cyclopedia of Agriculture; Plumb's Types and Breeds of Farm Animals; Plumb's Beginnings in Animal Husbandry; Harper's Animal Husbandry; Gurler's The Farm Dairy; Wilcox's Farm Animals; Burkett's Farm Stock; Smith's Profitable Stock Feeding; Farmers' Bulletins 55, 63, 106, 206, 280, 346, 350, 351, 413, 588, 602; State College Bulletins.

1. Name the beef breeds of cattle.
2. Name the milk breeds.
3. Name the dual-purpose breeds.
4. Tell how a dairy barn should be built and equipped.
5. What care should a dairy cow receive?
6. How should a dairy cow be fed?
7. Judge dairy cows (use score card).
8. What are the diseases of dairy cattle?
9. What may be done to prevent them?
10. How are the most paying dairies in your district handled?

HORSES

References.—Gay's Productive Horse Husbandry, also Principles of Judging Livestock; Plumb's Types and Breeds of Farm Animals, also Beginnings in Animal Husbandry; Burkett's Farm Stock; Wilcox's Farm Animals; Bailey's Cyclopedia of Agriculture, Vol. III; Robert's The Horse; Harper's Animal Husbandry; Farmers' Bulletins 22, 170, 179, 619; Bureau of Animal Industry Bulletins 37 and 61; University of Illinois Bulletins 122, 141, 150; Purdue University Bulletin, Vol. XIII, No. 109; Pennsylvania State College Bulletin 117; Your State College Bulletins.

1. Types of horses, draft, road, racer, and pony.
2. Judge light horse (use score card).
3. Judge draft horse (use score card).

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* No topic illustrates better than this one does the possibilities for teaching from these outlines. Here is two or more weeks' work outlined. If each teacher makes a lesson plan, she will find one topic covers plenty of material for one or more recitations.

4. How should a horse be fed to get good work from him?
5. What can you tell of the stabling and care of a horse?
6. What blemishes are common to horses of your locality?
7. How may they be prevented? Cured?
8. What diseases have horses in your neighborhood?
9. How may they be prevented? Cured?
10. Are farmers in your locality making money on horses? How are they handling them?

SHEEP

References.—Texts on Agriculture; Bailey's Cyclopedia; Plumb's Types and Breeds of Farm Animals; Doan's Sheep Feeding and Farm Management; Burkett's Farm Stock; Wilcox's Farm Animals; University of Illinois Bulletin 129; Farmers' Bulletins 49, 96, 159; United States Bureau of Animal Industry Bulletins 21, 63, 77, and Circulars 18, 94; Purdue University Bulletin, Vol. XV, No. 147; State College Bulletins; Coffey's Productive Sheep Husbandry.

1. Name the different types and breeds.
2. What breed is best for your home locality?
3. What care do sheep need?
4. How should sheep be fed?
5. What are the diseases of sheep?
6. Do sheep pay?
7. How do the men who are making money on sheep handle them?

SWINE

References.—Burkett's Farm Stock; Plumb's Types and Breeds of Farm Animals; Wilcox's Farm Animals; Cobourn's Swine in America; Craig's Diseases of Swine; Fulton's Home Pork Making; Farmers' Bulletin 272; Texts on Agriculture; Bailey's Cyclopedia; State College Bulletins; Day's Productive Swine Husbandry; Farmers' Bulletin 205, Pig Management.

1. Is the swine industry paying in your locality?
2. How does the housing and care of swine differ from that of cattle?
3. What are the diseases peculiar to swine?
4. What can be done to prevent them?
5. Score two or more hogs (use the most up-to-date card for your section of the country).
6. How are hogs cared for and fed by the best farmers of your locality. Do they consider hogs paying animals?

AGRICULTURE IN LITERATURE

High School Note Books.—High school pupils who live in the country should be taught to keep an agricultural note book and when they come to a pat sentence or paragraph, jot it down or copy it at once in their note book. A splendid booklet could be made by keeping sentences and paragraphs from Cicero and Virgil. The following is given to show what may be done. This is a study in

ROMAN FARM MANAGEMENT

The work of gathering some of the literature on agriculture and presenting it to English readers in an attractive and helpful form has been done most charmingly by a writer who signs himself "A Virginia Farmer." His book, called "Roman Farm Management," is so cleverly done that it makes us believe that we are again to return to the time when our cultured leaders will live in the country, as did Washington and Jefferson, and will be real husbandmen. Our Virginia Farmer has gathered together the extracts from Cato and Varro so far as they help us to understand the new science created within the last five years, and which we call Farm Management. The translation of the Virginia Farmer is free, and I have dared to go even farther, and as in some of our Source Histories, take only such sentences from Cato and Varro and arrange them in such an order as I think will give the reader both an idea of what we mean by Farm Management, and a little of the pleasure that comes to one who deals with rural life problems when he reads "Roman Farm Management."

"First of all," say our Latin authors, "we must have a definition . . . For I have observed that those who write on agriculture, whether in Greek or Punic or Latin, wander widely from their subject. . . . Agriculture is not only an art, but an art which is useful and important. It is, furthermore, a science which teaches how every kind of land should be planted and cultivated . . . The Greek writers who have treated incidentally of agriculture are more than fifty in number . . . Those whom you may consult with profit are Hieron . . . Democritus . . . Xenophon . . . Aristotle . . . The agricultural writer of the greatest reputation is, however, Mago, the Carthagenian who wrote in the Punic tongue, and collected in twenty-

eight books all the wisdom which before him had been scattered in many books.

"When you have decided to purchase a farm, be careful not to buy rashly; do not spare your visits and do not be content with a single tour of inspection. . . . Beware that you do not rashly condemn the experience of others. . . . Know that with a farm, as with a man, however productive it may be, if it has the spending habit, not much will be left over. . . .

"Four things must be considered in respect of the physical characteristics of the farm; its conformation, the quality of the soil, its extent, and whether it is naturally protected. . . . Fat soils are apparent from the heavy growth of their vegetation. . . . There are four considerations in this respect also; whether the neighborhood bears a good reputation; whether it affords a market to which our produce can be taken and whence we can bring back what we may require at home; whether there is a good road or river leading to the market; and fourth, whether there is in our immediate vicinity anything which may be to our advantage or disadvantage. . . . Of these four considerations the most important is whether the neighborhood bears a good or bad reputation. . . . Be a good neighbor. . . . If the neighbors regard you kindly, you will find a readier market for what you have to sell . . . you will more easily get your work done. . . . If misfortune overtake you (which God forbid!) they will protect you with kindly interest. . . .

"In his youth, a farmer ought diligently to plant his ground, but he should ponder before he builds. . . . It is time to build when you have reached your thirty-sixth year. . . . When you do build, let your buildings be proportionate to your estate, and your estate to your buildings. . . . Build your dwelling house in accordance with your means. . . . I maintain that the more appearances are considered, the greater will be the profit, as, for instance, orchards should be planted in straight lines . . . . the point is that if each plant is set with reference to others they occupy less land and are less likely to screen from one another.

"A corn plant consists of a culm bearing at its head a spike, which, when it is not mutilated, has, as in barley and wheat, three parts, namely, the grain, the glume, and the beard, not to

speak of the sheath which contains the spike while it is being formed. The grain is that solid, interior part of the spike; the glume is the hull, and the beard those long, thin needles which grow from the glume. . . . The etymology of the word *gluma* seems to be from *glubere,* to strip. . . . The beard we call *arista,* because it is the first part of the corn to dry (*arescere*), while we call the grain *granum,* from the fact that it is produced (*gerere*), for we want corn to produce grain, not glumes or beards.

"A field ought to lie fallow every other year, or at least be planted with some crop which makes less demand upon the soil. . . . You should take care not to plant alfalfa in soil which is too dry or too wet. . . . The authorities say that if the soil is in proper condition a *modius* [peck] and a half of alfalfa seed will suffice to sow a *jugerum* [three-fifths of an acre] of land."

"I think," continues Varro, "that there are three branches of farm management which are undertaken for profit, namely: agriculture [agronomy], live stock, and the industries peculiar to the steading [homestead] . . . The art of feeding live stock should really be divided into two branches, as is not yet fully appreciated; one relating to the steading, the other to the stock pastured in the fields. . . .

"There are two modes of human life, my dear Pinnius, which are manifestly as different in their origin as in their habitat, that of the country and that of the town. Country life is much more ancient, for time was when men lived altogether in the country and had no towns. And as life in the country is the more ancient, so it is the better life. . . . God made the country and man made the town."

Divina natura dedit agros, ars humana aedificavit urbes.

ADDRESSES OF EXPERIMENT STATIONS

Alabama—*Auburn, Unionville* and *Tuskegee.*
Alaska—*Sitka.*
Arizona.—*Tucson.*
Arkansas—*Fayetteville.*
California—*Berkeley.*
Colorado—*Fort Collins.*
Connecticut — *New Haven* and *Storrs.*
Delaware—*Newark.*
Florida—*Gainesville.*
Georgia—*Experiment.*
Hawaii—*Honolulu.*
Idaho—*Moscow.*

Illinois—*Urbana.*
Indiana—*Lafayette.*
Iowa—*Ames.*
Kansas—*Manhattan.*
Kentucky—*Lexington.*
Louisiana.—*Baton Rouge* and *Calhoun.*
Maine—*Orono.*
Maryland—*College Park.*
Massachusetts—*Amherst.*
Michigan—*East Lansing.*
Minnesota—*St. Paul.*
Mississippi—*Agricultural College.*
Missouri—*Columbia.*
Montana—*Bozeman.*
Nebraska—*Lincoln.*
Nevada—*Reno.*
New Hampshire—*Durham.*
New Jersey—*New Brunswick.*
New Mexico—*Agricultural College.*
New York—*Ithaca.*
North Carolina—*Raleigh.*
North Dakota—*Agricultural College.*
Ohio—*Wooster.*
Oklahoma—*Stillwater.*
Oregon—*Corvallis.*
Pennsylvania—*State College.*
Porto Rico—*Mayaguez.*
Rhode Island—*Kingston.*
South Carolina—*Clemson College.*
South Dakota—*Brookings.*
Tennessee—*Knoxville.*
Texas—*College Station.*
Utah—*Logan.*
Vermont—*Burlington.*
Virginia—*Blacksburg.*
Washington—*Pullman.*
West Virginia—*Morgantown.*
Wisconsin—*Madison.*
Wyoming—*Laramie.*

BARN-YARD MANURES

Questions frequently arise as to which is best of the different farm manures. Of course the answer depends upon what the plants need. At 20 cents for nitrogen, 6 cents for phosphoric acid, and 4½ cents for potash, Professor Davis gives the following ("Productive Farming," p. 362):

Manure	Pounds per 1000			Value of 1000 pounds of animal per year	Value per ton
	Nitrogen	Phosphoric acid	Potash		
Cow manure	3.4	1.6	4.0	$39	$1.91
Hen droppings	16.3	15.4	8.5	..	9.21
Horse manure	5.8	2.8	5.3	42	3.13
Hog	4.5	1.9	6.0	80	2.56
Sheep	8.3	2.3	6.7	46	4.20
Mixed stable manure	5.0	2.6	6.3	..	2.88

The above are on the assumption that the manures are fresh. The nitrogen disappears very rapidly as the manure ferments, the potash and nitrogen both readily leach away if manure is piled where rained on. Then, too, a farmer may supply nitrogen to his soil by using the legumes and hence not have to pay anything like 20 cents per pound.

SPRAY MIXTURES

Biting insects may be killed with some form of arsenic such as Paris green or white arsenate of lead.

Dry Paris Green

Paris green	1 pound
Lime, dust, or flour..	4 to 20 pounds.

Wet Paris Green

Paris green	½ to 1 pound
Lime	½ to 1 pound
Water	50 to 100 gallons

Plant lice and other soft-bodied, sucking insects may be kept in check or smothered with an oil emulsion.

Kerosene Emulsion

Hard soap	½ to 1 pound
Soft water	1 gallon
Kerosene	2 gallons

Dissolve the soap by slicing it and boiling in the soft water. Add the kerosene to the soap suds while hot but keep away from fire. Agitate or stir the mixture until it becomes a creamy mass of even texture with no signs of either oil or soap suds. This emulsion may be kept indefinitely and used when wanted. Dilute with 15 gallons of water to one of emulsion.

Scale and shelled insects are best killed with a lime-sulfur mixture. This must be so strong that it would kill foliage, hence it is applied before the leaves appear. March or February are the months in which we generally do the spraying for the San José scale and for this we use the lime-sulfur mixture which is as follows:

Lime-sulfur Wash

Powdered flour of sulphur	15 pounds
Burned lime	15 to 20 pounds
Water	50 gallons

The lime and sulfur are boiled over a fire for about half an hour, in from 10 to 25 gallons of water. Another form of the lime-sulfur is called the self-boiled because the heat of the slacking lime is used for the boiling. To about 8 pounds of caustic lime add enough water to start the lime to slacking. Then sift in about 7 pounds of sulfur. The mixture must be stirred constantly to keep it from forming lumps, especially at the bottom. The mixture is strained through a cloth and

diluted with 50 gallons of water. This is used on the foliage for fungous diseases.

For plant diseases, most people prefer the

Bordeaux Mixture

Slacked lime	5 pounds
Copper sulfate (bluestone)	5 pounds
Water	50 gallons

The copper sulfate is dissolved in water at the rate of one gallon of water to one pound of copper sulfate. The lime is slacked until it is a creamy mass. The two are strained and then poured into a third receptacle together, that is, mixed when or as poured. This mixture does not keep well, hence the lime and bluestone should not be mixed until time to use. Neither lime-sulfur nor Bordeaux mixture is easily made, hence one should visit a spray demonstration, or help a practical horticulturist before expecting to get good results from using the lime-sulfur or Bordeaux mixtures.

FORMALDEHYDE FOR POTATO SCAB

Potatoes for scab and oats for smut are treated as given under Smut in Chapter XI, that is, soaked in formaldehyde. The potatoes are put into a coarse burlap sack. A barrel is half filled with water and into it is poured a half-pound of the formaldehyde. The sack of potatoes is lowered into the solution and allowed to soak for about one to one and one-half hours. The potatoes are then removed, poured out on to the grass or floor, allowed to dry, and then cut for planting.

Seed Per Acre

Alfalfa	20 to 30 pounds.	Millet	1 to 3 pecks.
Barley	8 to 10 pecks.	Oats	2 to 3 bushels.
Blue-grass	20 to 25 pounds.	Oats and Canada peas, 6 pecks each.	
Buckwheat	3 to 5 pecks.	Potatoes	6 to 18 bushels.
Corn	10 to 12 ears per acre.	Rye	3 to 8 pecks.
Corn, checked	6 to 8 quarts.	Timothy	10 to 20 pounds.
Corn for ensilage	9 to 10 quarts.	Timothy and clover mixed	10 to 12 pounds of each.
Clover (alone)	10 to 15 quarts.	Vetch and grain mixture	4 to 5 pecks of each.
Cowpeas	4 to 7 pecks.	Wheat	6 to 9 pecks.
Cotton, upland	2 to 4 pecks.		
Mangles	5 to 8 pounds.		

Distances for Planting Fruit

Fruit trees	Feet apart	Small fruit	Feet apart
Apples	30 to 40	Blackberries	4 to 7
Apricots	15 to 20	Cranberries	1 to 2
Cherries	15 to 20	Currants	4 to 5
Oranges	20 to 30	Gooseberries	4 to 5
Peaches	15 to 20	Grapes	6 to 12
Pears	20 to 30	Raspberries	3 to 5
Dwarf pears	10 to 15	Strawberries, hedge-row	1 to 3
Plums	15 to 20	Strawberries, matted-row	1 to 4
Quinces	10 to 15	Strawberry-raspberry	2 to 5

Garden Vegetable Planting Table

Vegetable	Feet apart		Vegetable	Feet apart	
	Rows	Plants in row		Rows	Plants in row
Asparagus	3 to 4	1 to 2	Parsley, peas	1 to 3	drilled
Beans, bush and pole	3	1 to 2	Pepper, potatoes	2 to 3	1 to 2
Beets	1 to 2	drilled	Rhubarb	3 to 4	2 to 4
Cabbage and cauliflower	2 to 3	2 to 3	Radish	1 to 3	drilled
			Salsify	1 to 3	drilled
Carrots	1 to 2	drilled	Spinach	1 to 3	drilled
Corn, sweet	3 to 3½	1 to 2	Squash, pumpkins	6 to 8	6 to 8
Celery	3 to 3½	½ to 1	Sweet potatoes	3 to 4	2 to 2½
Cucumbers, melons	4 to 6	4 to 6	Turnips	1 to 3	drilled
Egg plant	3 to 3½	1 to 2	Tomatoes	3 to 4	3 to 4
Lettuce, onions	1 to 3	drilled			

Summary of Average Yields of Corn

Two kernels per hill			Three kernels per hill		
Distance between hills (inches)	Number of stalks per acre	General average for three fields	Distance between hills (inches)	Number of stalks per acre	General average for three fields
44 x 44	6480	47.7	44 x 44	9720	51.6
44 x 39.6	7200	50.0	44 x 39.6	10800	51.9
39.6 x 39.6 36 x 44	8000	51.9	39.6 x 39.6 36 x 44	12000	52.3
33 x 44 36 x 39.6	8800	52.8	33 x 44 36 x 39.6	13200	51.4
36 x 36 33 x 39.6	9680	54.5	36 x 36 33 x 39.6	14520	49.1
33 x 36	10560	55.0	33 x 36	15840	49.1
33 x 33	11520	54.0	33 x 33	17280	46.8

AN AGRICULTURAL LIBRARY FOR TEACHERS AND SCHOOLS

Nature Study:

SCHMUCKER—THE STUDY OF NATURE,
J. B. Lippincott Company, Philadelphia.

HODGE—NATURE STUDY AND LIFE,
Ginn & Company, New York and Chicago.

Seed Selection and Plant Breeding:

DE VRIES—PLANT BREEDING,
The Open Court Publishing Co., Chicago.

COULTER—FUNDAMENTALS OF PLANT BREEDING,
D. Appleton & Co., New York.

Pets and Domestic Animals:

COMSTOCK—THE PET BOOK,
Comstock Publishing Co., Ithaca, New York.

GAY—PRODUCTIVE HORSE HUSBANDRY,
J. B. Lippincott Company, Philadelphia.

DAY—PRODUCTIVE SWINE HUSBANDRY,
J. B. Lippincott Company, Philadelphia.

LEWIS—PRODUCTIVE POULTRY HUSBANDRY,
J. B. Lippincott Company, Philadelphia.

COFFEY—PRODUCTIVE SHEEP HUSBANDRY,
J. B. Lippincott Company, Philadelphia.

Stock and Grain Judging:

GAY—PRINCIPLES AND PRACTICES OF STOCK JUDGING,
The Macmillan Company, New York.

MONTGOMERY—THE CORN CROPS,
The Macmillan Company, New York.

BOWMAN AND CROSSLEY—CORN,
Bowman Publishing Co., Waterloo, Iowa.

Feeds and Feeding:

WOLL—PRODUCTIVE FEEDING OF FARM ANIMALS,
J. B. Lippincott Company, Philadelphia.

Farm Management:

WARREN—FARM MANAGEMENT,
The Macmillan Company, New York.

CARD—FARM MANAGEMENT,
Doubleday, Page & Co., New York.

The Soil and Fertilizers:

FLETCHER—SOILS,
Doubleday, Page & Co., New York.

KING—SOIL MANAGEMENT,
Orange Judd & Co., New York.

WHEELER—MANURES AND FERTILIZERS.
The Macmillan Company, New York.

Birds and Insects:

WEED AND DEARBORN—BIRDS IN RELATION TO MAN,
J. B. Lippincott Company, Philadelphia.

SMITH—OUR INSECT FRIENDS AND ENEMIES,
J. B. Lippincott Company, Philadelphia.

SAUNDERS—INSECTS INJURIOUS TO FRUIT,
J. B. Lippincott Company, Philadelphia.

SNYDER—FIGHTS OF THE FARMER,
J. B. Lippincott Company, Philadelphia.

Plant and Animal Diseases:

DUGGAR—FUNGOUS DISEASES OF PLANTS,
Ginn & Company, New York.

BREWER—RURAL HYGIENE,
J. B. Lippincott Company, Philadelphia.

LIPMAN—BACTERIA IN RELATION TO COUNTRY LIFE,
The Macmillan Company, New York.

CRAIG—COMMON DISEASES OF FARM ANIMALS,
J. B. Lippincott Company, Philadelphia.

Weeds:

PAMMEL—WEEDS OF THE FARM AND GARDEN,
Orange Judd & Co., New York.

Rural Social Institutions:

CUBBERLY—RURAL LIFE AND EDUCATION,
Houghton Mifflin & Co., Chicago.

BAILEY—THE COUNTRY LIFE PROBLEM,
The Macmillan Company, New York.

GILLETTE—CONSTRUCTIVE RURAL SOCIOLOGY,
Sturgis and Walton, New York.

BETTS AND HALL—BETTER RURAL SCHOOLS,
Bobbs Merrill Co., Indianapolis.

REPORT OF THE COUNTRY LIFE COMMISSION,
Sturgis and Walton, New York.

For All:

BAILEY—CYCLOPEDIA OF AGRICULTURE (4 vols.),
The Macmillan Company, New York.

Send to the United States Department of Agriculture and to the United States Bureau of Education for lists of publications of Agriculture, Vocational Training and Rural Life.

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